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THE INTERNATIONAL WEEKLY OF THE PAPER AND PULP INDUSTRY AND THE PIONEER PUBLICATION IN ITS FIELD

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Vol. CV
No. 13

66th Year

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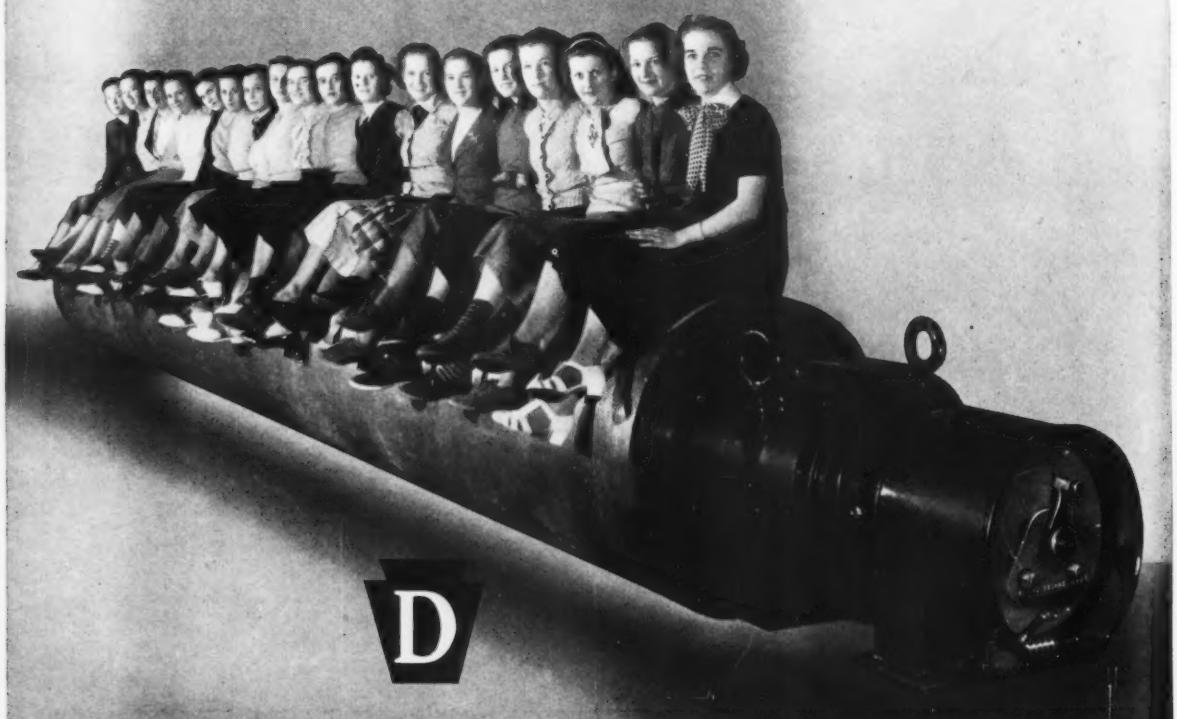

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Entered as second class matter at the Post Office at East Stroudsburg, Pa., under the Act of Congress of March 3, 1879. Published every Thursday by the Lockwood Trade Journal Co., at 34 N. Crystal St., East Stroudsburg, Pa. Executive and Editorial office: 15 W. 47th St., New York, N. Y. Domestic subscription U. S. and possessions, $4.00 per year.

PAPER TRADE JOURNAL

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Published Every Thursday by the LOCKWOOD TRADE JOURNAL CO., Inc.

Executive and Editorial Offices: 15 West 47th Street, N. Y. C.
Western Rep.—H. K. Vinton, 123 W. Madison St., Chicago, Ill.

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TABLE OF CONTENTS

Newsprint Productions in Canada Rising 17
C. H. Allen Gets Patent on Hydrator 17
News of the Wisconsin Paper Industry 18
Canada Looks to Good Paper Demand 19
H. T. Randall Injured in Accident 19
Wait for Demand to Increase Paper Prices .. 20
Uses for Sulphite Pulp Expanding 21
Obituary 21
Government Paper Bids 21
Albert D. Merrill Gets Patent 21
Financial News of Pulp and Paper Industry .. 22
Union Bag Approve 4-for-1 Stock Split 22
Estimate Brown Taxes at Over $800,000 22
New Group for Brown Co. Delay 22
Grays Harbor to Offer Stock 24
Louisiana May Reduce Sulphur Tax 24
Mead Corp. Increases Income 24
Seek Reductions on Valuations 24
Boiler Water Treated to Prevent Carry Over 26
Construction News 32
Close Case Against Corrugated Container 34
Newsprint Production Increases 34
Pulpwood Co. Increases Directorate 34
Editorial 36
Powell River Makes New Agreement 37
Production Ratio Report 37
New $1,500,000 Electric Plant 37
Technical Section
A study of the Retention of Dyestuffs on Paper Making Fibers Under Various Conditions 39
Some Aspects of Starches in the Paper Industry 46
The Rosenblad System for Recovery of Heat and Sulphur Dioxide in the Chemical Wood Pulp Industry 52
Imports of Paper and Paper Stock 57
New York Market Review 60
Miscellaneous Markets 62
Market Quotations 64

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Want and For Sale Advertisements Pages 66, 67, 68

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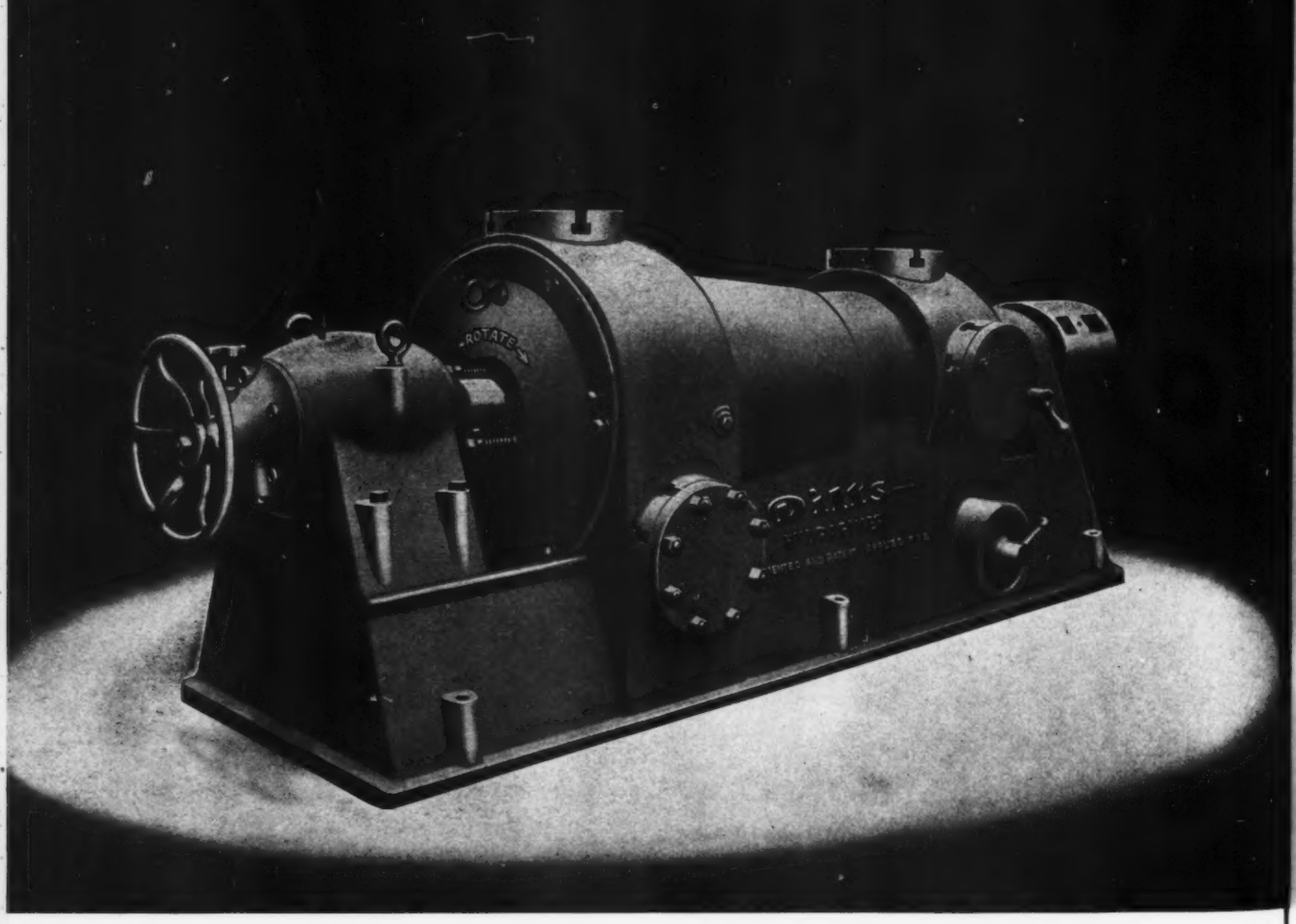

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PAPER
Established Feb. 17, 1899
Consolidated Nov. 16, 1899
with Paper Trade Journal.
Vol. CV, No. 13 Thursday, September 23, 1937
Established Sept. 21, 1918
Consolidated Feb. 19, 1925
with Paper Trade Journal.

Newsprint Production In Canada Rising

Output of Newsprint for August 18 Per Cent Higher Than Like Month Last Year — Rail Rate Reduced As Tonnage Increases — New Town Founded by Paper Co. Elects Council — Demand for Paper Serviettes

[FROM OUR REGULAR CORRESPONDENT]

MONTREAL, Que., September 20, 1937—Newsprint production in Canada is continuing to break all previous monthly records, the output for August, at 318,713 tons, having been 18 per cent higher than that for August, 1936. The percentage of increase seems to be more or less stabilized, for when the production for the first eight months of the present year, totalling 2,416,016 tons, is compared with the production for the similar period of last year, it shows an increase for the period of 18.8 per cent. Producers here, however, do not overlook the fact that demand is not all on account of current consumption. They know that publishers are building up more than normal stocks of newsprint, partly to offset possible shortage in the months of heaviest demand and partly to provide against the increase in price which becomes effective on January 1st. For these reasons producers are quite prepared to see demand somewhat taper off in the early months of 1938.

Rail Rate Reduced on Newsprint

Due to the fact that shipments of newsprint to Eastern United States points via the St. Lawrence river and the canal route via the Richelieu river and Lake Champlain have been growing rapidly, with an increasing number of new vessels being put on these routes. The Boston and Maine, the New York Central and other railways are reducing the freight rates on newsprint from May 1st to November 1st, the season of open navigation on the river routes. The new rates, which have been approved by the U. S. Interstate Commerce Commission amount to about 10 cents per 100 pounds, the rates authorized being 31 cents per 100 pounds from Jonquière, Donnacona, Grand Mere and Shawinigan Falls, Que., and Millinocket, East Millinocket and Woodland, Me. From St. Joseph d'Alma, Que., to Philadelphia, the new rate is 33½ cents per 100 pounds. To intermediate points higher rates have been authorized.

Bay Comeau Newsprint Plant

From Bay Comeau, where the Ontario Paper Company is establishing a new 350-ton per day plant for the manufacture of newsprint, it is announced that the first unit of the power development at Outardes Falls will be put into operation within two weeks. It has a capacity of 35,000 h.p., and a second unit of similar capacity is expected to be ready for operation by November 1st. This will complete the power section of the development and permit activities to be concentrated on the newsprint mill, which is scheduled to come into operation of July 1st next. At the present time all construction activities are well ahead of schedule.

New Paper Town Elects Council

During the past week the new town of Comeau Bay, established by the paper company here installed its first Town Council and elected its first mayor, H. A. Lewell, in charge of woodlands operations for the company, being elected to the latter office.

Market for Paper Serviettes

G. L. McColl, Canadian Trade Commissioner in Bristol, England, reports that there is a growing market in the South Midlands for paper serviettes. Before the advent of tariff protection Austrian firms had the bulk of this trade. One or more of these foreign manufacturers have established plants in England. Wholesale houses, railways, and a few of the multiple shop or chain-store organizations buy direct from the English manufacturers and to a limited extent from agents who represent foreign firms. Although some ten firms in the United Kingdom are manufacturing this product, there is a considerable quantity imported from foreign sources, and it should be possible, Mr. McColl says, for Canadian firms to obtain a part of that overseas trade.

C. H. Allen Gets Patent on Hydration

[FROM OUR REGULAR CORRESPONDENT]

GLENS FALLS, N. Y., September 20, 1937.—Carlton H. Allen, of this city, has been granted a patent on a new kind of hydrator which has several unique features. The device is described as comprising a casing forming a passage for the flow of material through it, a shaft extending axially in the casing, a plurality of first bevel gears non-rotatably mounted within the casing, various other gears and numerous special features in addition. The hydrator is to be used for treatment of pulp and paper stock but the invention has not yet been assigned to any manufacturing concern.

News of the Wisconsin Paper Industry

Planting of Nearly 8 Million Trees To Be Made In Nicolet National Forest — Members of I.P.C. Study In Woods — Ernst Mahler Heads Institute of Paper Chemistry — Beer Cartons Supply Waste Paper Stock.

[FROM OUR REGULAR CORRESPONDENT]

APPLETON, Wis., Sept. 20, 1937—A planting of 7,900,000 trees is to be made this fall in the Nicolet National Forest in northern Wisconsin, according to announcement of R. A. Rindt, assistant forest supervisor. Most of the work will be done by CCC crews under the supervision of forest rangers. Species to be planted include white, red and jack pine and a small amount of white spruce. Plantings will include 3,337 acres in the Oconto district, 1,413 acres in the Phelps district, 1,805 in the Florence district, 7,196 at Peshtigo, and 583 in the Argonne district. More mature trees will be planted this year so a larger number will survive. The seedlings are being supplied by the forest nursery at Rhinelander, Wis.

Whiting-Plover Workers to Unionize

Approximately 80 employees of the Whiting-Plover Paper Company, Stevens Point, Wis., have made application for a charter in a union that is to be affiliated with the International Brotherhood of Paper Makers. Additional applications are being sought so the union can become the collective bargaining agent.

Members of I. P. C. Study Forests

Eighteen members of the first year class of the Institute of Paper Chemistry, Appleton, Wis., are spending two weeks in the forest sections of Wisconsin and Upper Michigan studying wood and forest operations. They are in charge of Robert Rogers, of the Kimberly-Clark Corporation. Logging camps and mills will be visited so the students become acquainted with the first steps in the manufacture of paper. Several paper mills in that section also will be visited.

Hummel and Downing Expand

Hummel & Downing Co., Milwaukee, Wis., carton manufacturers, has leased 40,000 square feet of floor space in the machine shop building of the former National Brake and Electric Company. The lease is on a month to month basis. The space will be used for paper storage. The company already has moved 1,000 tons to the building, and expects to put in an additional 4,000 tons.

Mahler Heads I. P. C. Board

Ernst Mahler, executive vice-president of the Kimberly-Clark Corporation, was re-elected president of the board of trustees of the Institute of Paper Chemistry, affiliated with Lawrence College, at the annual meeting at the Institute last week. All of the other officers and trustees whose terms expire also were re-elected. The officers are: D. C. Everest, Marathon Paper Mills Company, vice-president; Westbrook Steele, executive director; John Strange, secretary, and Ralph J. Watts, treasurer. The last three men named are members of the Institute staff.

Trustees whose terms expired are: Ernst R. Behrend, Erie, Pa.; D. C. Everest, Rothschild, Wis.; Rex W. Hovey, Rumford, Me., and David Luke, Jr., West Virginia. Other members of the board are: Dr. Thomas N. Barrows, president of Lawrence College, D. K. Brown, H. P. Carruth, R. J. Cullen, Ernst Mahler, George H. Mead, Hugh Strange, and J. D. Zellerbach.

Continental Requests Tax Reductions

Reduction of its property tax assessment is asked by the Continental Paper and Bag Company on its mills at Menominee, Mich., with the Union Falls Power Company also participating in the demand. Members of the Michigan tax commission are making a review of the assessment made by the City of Menominee, and have taken the matter under advisement. The assessment valuation of their property, including an unused paper mill and dam in the city, was boosted this year from $250,000 to $385,000. The commissioners took with them exhibits offered by the paper company.

Pulpwood Steamer in Mishap

The steamer Inca, pulpwood carrier for the Northern Paper Mills, Green Bay, Wis., rammed the Kewaunee, Green Bay and Western railroad bridge at Green Bay last week, when blown from its course by a strong wind. The bridge was put out of commission for railroad use for more than 12 hours by the impact.

Beer Cartons Furnish Waste Stock

One of the important sources of supply to paper mills for baled carton stock is the Pabst Brewing Company plant at Milwaukee, Wis. The bottles are returned in the paper cartons generally used nowadays, and were too numerous to handle on the production line. A $10,000 hydraulic baler has been installed, which puts up bales of 1,100 to 1,200 pounds. A four-man crew bales 3,600 cartons an hour.

Badger Mill Head Entertains

E. A. Meyer, president of Badger Paper Mills, Inc., Peshtigo, Wis., entertained 15 representatives of its Chicago jobbing house at the mill last week. A part of the recreation included a boatride to Ephraim, Wis., aboard Mr. Meyer's yacht, the Julia Lynn, and the yacht Framona, owned by Frank Lauerman, Jr.

Hackbert-McCarey Nuptials

C. R. Hackbert, a chemist in the research laboratory of the Kimberly-Clark Corporation at Kimberly, Wis., and Miss Marjorie McCarey of Appleton, Wis., were married September 8 at St. Matthew's Lutheran church at Appleton.

Miss Suzanne Jennings of Appleton, Wis., and George Dyer Beck of Philadelphia, were married September 11 at a candlelight ceremony at Riverview Country Club, Appleton. Miss Jennings is a daughter of Elmer H. Jennings, sales manager of the Thilmany Pulp and Paper Company, Kaukauna, Wis.

Canada Looks For Good Paper Demand

Fine Paper Mills Busy — Tissues Show Good Sales Volume — Special Department of Northern Ontario Affairs Promised to Promote Pulp and Paper—Price of $50 Per Ton on Newsprint May Be Set in New Schedule.

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., Sept. 20, 1937—Paper trade progress over the past few weeks has been somewhat spotty. Following the high point earlier in the year, and the depression in early summer, things picked up notably until late in August. At the moment business is quiet all along the line, but in general the situation is accepted philosophically. The course which business seems to follow these days does not leave much room for sustained pessimism or undue enthusiasm. A few days of blank order book pages are usually followed by an avalanche of business and perhaps then by another brief slump. As the result the opinion one gets in contact with the trade here and there, is rather apt to depend upon what they happen to have on their order files that day or the day before.

While the wholesale paper trade is undoubtedly quiet just now the mill trade may be said to be quite fairly active with most of the fine paper plants running well up to capacity under a well-sustained demand for book, writing, bonds and offsets. The holiday season is just about over now and both millmen and wholesalers have reason to believe that the fall is going to produce good business.

The coarse paper trade and paper bags have improved slightly and there is a fair amount of various coarse paper lines selling now, with a prevailing tendency on the part of the consumer to buy by reason of the possibility of an early rise in prices. Mills manufacturing lightweight papers such as tissues, toilets, paper napkins and similar lines, report quite a good volume of sales and the outlook for future business good. Paper converting lines for the most part are lagging in sales volume and envelope manufacturers are somewhat quiet. The printing trade is inclined to be quiet and paper requisitions from this source are light.

Pulp Exports May Be Banned

Establishment of a special Department of Northern Ontario Affairs to promote pulpwood and paper production and speed up the industry, was promised by Hon. W. Earle Rowe, speaking at Fort William last week. The export of raw pulp will be banned and Canadian mills will be established to give work to Canadians. Allegations that Ministers in the present Government owed Crown Timber dues to the Province and that they were now receiving more timber limits, was made by Mr. Rowe.

Reserve Newsprint Holds Threat

Directors of the Great Northern Paper Co. are scheduled to meet at this time to determine on the company's newsprint policy for the first half of 1938. The International Paper Co. and a number of the Canadian companies have already notified their customers that the price will be $50 a ton, but importance attaches to whatever action is taken by Great Northern. While the old-time interlocking contract, which permitted a mill with a capacity of more than 100,000 tons annually to set the price for the balance of the industry has been done away with, still about 120,000 tons of Canadian tonnage are affected by this clause. This proportion of Canadian tonnage will be affected by Great Northern's policy but it is confidently expected that the $50 price will prevail for the balance of the American business.

Great Northern's policy is awaited with considerable interest for another reason; its possible affect on the price for the last half of 1938 which, in ordinary circumstances, will be announced in October or November. If Great Northern sets a price of less than $50 for the first half of the year, it will not be an easy matter to advance the price in the last half of the year.

Opinion is divided as to what Great Northern will do. The uncertainty is intensified by the fact that there has been no intimation, official or otherwise, as to what its schedule is likely to be. In some quarters it is said that the company will set a price of $47.50 or $48 a ton for the first six months, or even go so far as to set a price for the whole year. There are those who feel that Great Northern may follow the other companies and back the $50 a ton price, but this seems unlikely in view of the company's independent attitude in the past.

Abitibi Plan Gets Support

Following the recent visit to Winnipeg of J. P. Ripley, chairman of the bondholders' committee for Abitibi Power & Paper Co. informants in the Western city indicate that larger bondholders in that vicinity are favorable to the plan of reorganization. A few weeks ago a bondholders' committee, headed by W. E. Gower, made criticism of the reorganization plan drafted by the official bondholders' committee. Subsequently, however, the Winnipeg group appears to have been inactive and it is said that western investors are favorable to the plan.

H. T. Randall Injured in Accident

[FROM OUR REGULAR CORRESPONDENT]

DAYTON, Ohio., September 20, 1937.—Herbert T. Randall, a director of the Champion Paper and Fibre Company, and who is in charge of the mechanical department of that well-known Hamilton concern, suffered a broken right collar bone in an automobile accident last week at Walloon Lake, Michigan, where he was vacationing with Mrs. Randall and their two children.

Walloon Lake is in the northern part of Michigan.

According to word received from the hospital at Petoskey, Mich., where Mr. Randall was taken after the accident, he was driving alone, near the northern resort, when his car skidded on a curve and left the road, crashing into a tree.

The road along which he was driving is not banked at the particular point where Mr. Randall's automobile skidded, while a steady rain on the recently oiled surface made driving precarious.

Wait for Demand to Increase Paper Prices

Fine Papers Give Strength to Moderately Active Trade — Meeting of N.P.T.A. Attracts Interest — Miller-Tydings Helps Boxboard Industry— Midwest Manufacturers Lose Lower Freight Fight—Other News.

[FROM OUR REGULAR CORRESPONDENT]

CHICAGO, Ill., September 20, 1937—There are no specific indications that the Chicago markets are soon to show any evidence of an advance in paper prices. Those interviewed feel very strongly that prices will not go forward to any appreciable extent until the "psychology" is better and until underlying demand comes to the front. Meanwhile, the local markets are comparatively colorless with only casual reports of exceptional business. Since the rise in some specialty grades a few weeks ago, local trade has moved in a narrow channel although everyone feels that price rises are only a matter of time.

Fine papers in general showed evidence of a strong undertone but buyers were none too plentiful and business indicated a tendency to go along with the general hesitancy in the business world. Books and covers were unchanged although both gave evidence of the fact that the advertising world was preparing to drive hard for business this fall. Groundwoods were unchanged while the newsprint circles were optimistic but not apparently faced with any more than an ordinary demand. Krafts were steady and, in company with other lines, have a sufficient raw material shortage to show immediate price strengthening if demand warranted. Sulphites showed no change. Waste papers locally continued to buck the national trend, were in demand and gave evidence that this market was now in the process of catching up with the business improvement the East experienced some weeks ago.

N. P. T. A. Program Ready

The stage is set for what promises to be one of the outstanding fall meetings of the National Paper Trade Association. Opening at the Stevens Hotel on Monday morning, September 20, the four-day session, as evidenced by the advance program, is crammed with interesting meetings. Exhibits on the fifth and sixth floors, in which some fifty paper firms are expected to participate, are a feature of the 1937 meeting.

On the afternoon of September 20 J. C. Aspley, publisher of the Dartnell Corporation, will open the meeting. During the same day sessions of the Book, Offset, Gummed Tape, Groundwood and Newsprint committees will be held while the Wrapping Paper Merchandise Committee will also hold its initial session. A general session in the afternoon is to be presided over by President F. B. Tracy, to be featured by Executive Committee meetings listing reports from a number of cities on management procedure in the paper distributing trade. The Survey and Traffic Committees are also scheduled for Monday afternoon while the Fine Paper Merchandising Committee will hold an evening session on the opening day.

Tuesday's meetings are opened by Committee meetings covering Writing Papers, Wrapping Papers, Wrapping Paper Specialties, Envelopes, Bags, Bristol Boards and Tags. During the afternoon of September 21 the Governing Committee of the Fine Paper and the Wrapping Paper Divisions will get together while an evening meeting of the Board of Directors of the N.P.T.A. is also on the busy calendar.

George Cobean, vice president of the Fine Paper division, presides at Wednesday morning meetings of that group while later in the day a general meeting of the Wrapping Paper division under Vice President Jamison is also to be held. A general meeting of the entire organization will be held Thursday morning, adjourning near the noon hour to permit participation in the final golf outing of the Salesmen's Association of the Paper Industry to be held at Olympia Fields Country Club the afternoon of September 23. Over 200 reservations for this annual outing have already been announced by golf chairman Ralph Burnett and two of Olympia Fields four courses are to be utilized.

The final speech of the session, at the Thursday morning general meeting, is to be given by Westbrooke Steele, director of the Institute of Paper Chemistry. Mr. Steele will discuss "Progress in the Paper Making Industry".

Lose Freight Rate Fight

Midwest paper manufacturers seem to have lost their fight to obtain lower freight rates on their products to southern points according to a statement that the Fort Wayne Corrugated Paper Company of Fort Wayne, Indiana, and fifteen other midwest paper and paperboard manufacturers received an adverse decision from the interstate commerce commission. This week the commission denied the application of the manufacturers for a postponement until next January of new rates on paper shipments and paperboard products which means, in effect, that the proposed rates will go into effect early next month. The rates are felt to be not as favorable to the midwest section as the rates from southern and midwest points are favorable to southern manufacturers.

Price Bill Aids Demand

The news that the Miller-Tydings Price Maintenance legislation and corresponding State legislation is materially aiding the paper box industry may come as a surprise to some. However, reports indicate that because of the new price maintenance legislation a quantity of private brands have been placed on the market and the organizations behind them are utilizing modern packaging to the fullest extent to compete with well known brands in the field. This information comes from the Container Corporation of America which also expects that largest earnings in its history and the possibility of actually doubling its best year when the fiscal year ends the last day of December. The company, breaking records the first half of 1937, ran into the summer reaction period but now finds Fall business sufficient to indicate the record year referred to above. The business of the folding box division is now reported as having

matched the sizeable gains in corrugated and solid fibre shipping containers. The Chicago concern, in addition to its paper box and allied lines, expect its 40,000 ton plant in Florida to soon be completed and to return dividends for the $2,750,000 approximate cost which was met from cash, earnings and a part of the proceeds from additional shares of stock to stockholders.

The speeding up of demand for paper boxes coming from the actions of private brand concerns in taking advantage of price mantenance legislation, is credited with having been a major factor in boosting the sales of these grades for the first seven months of 1937 to a point 10 to 15 per cent over the volume for a corresponding period in 1936.

Paper Production Scattered

The diversification of Illinois as an industrial State is evidenced by the fact that the State is listed as sixth in the production of paper in 1936. Illinois is reported by the Department of Census as having produced 551,414 tons of paper last year, an increase of over 14 per cent as compared with 1935. The entire United States produced 11,975,522 tons of paper during the year according to the Census figures. The five States ranking ahead of Illinois in the order named are Maine, Ohio, Wisconsin, Pennsylvania and New Jersey.

New Cromwell Folder

"When Precision Counts" is the subject of a new folder being issued to the trade this month by the Cromwell Paper Company of Chicago. A black and blue color combination with a nautical motif and printed on tympan stock serves to put over a strong message relative to the line of tympan papers carried by the Chicago concern.

Uses For Sulphite Pulp Expanding

VANCOUVER, B. C., September 13, 1937—British Columbia's pulp and paper industry is still in its infancy and nothing can hold it back. Its development is inevitable. This is the opinion of John F. Taylor of Hull, Que., secretary and sales director of E. B. Eddy & Co. Mr. Taylor is a prominent figure in the pulp and paper industry and attended the convention of the Canadian Chamber of Commerce at Vancouver, B. C. recently.

He stated he was convinced B. C. would steadily develop its pulp and paper industry, but believed greatest growth would come by broadening of the field for pulp rather than by expansion of the newsprint market, pointing to the capacity with which new uses for sulphite pulp were being found.

He stated sulphite pulp expansion in Ontario alone would total an investment of over $40,000,000 this year for that province alone, and while some of this amount represented paper production, the majority was being spent in development of sulphite pulp for rayon and pulp for cellophane and other industrial uses.

Reforestation was the biggest problem now confronting the industry, he declared, stating eastern experts estimated cutting at present rates would deplete eastern Canadian resources in 63 years. Immediate action was vital to halt exhaustion of one of the most valuable natural resources of the Dominion, he declared.

Obituary

Harold C. Eaton

Harold C. Eaton of 19 Worcester lane, Waltham, Mass., clerk of the corporation and a leading stockholder in the A. M. Eaton Paper Company of Waltham and Boston, is dead.

Mr. Eaton was born in Waltham 44 years ago. He was graduated from Waltham High School and a Boston business school. During the world war, he served with the 301st field artillery. He held membership in the Masons.

He leaves his widow, a daughter, Virginia, and a son, Robert Eaton, all of Waltham. Funeral services where held September 9 at 2:30 P. M. at his late home.

Frank Howard

[FROM OUR REGULAR CORRESPONDENT]

Vancouver, B. C., September 11, 1937—The death occurred at Powell River, B. C., recently, of Frank Howard, superintendent of the Powell River Company, and an employee of the company for the past fourteen years. Mr. Howard, who was one of the best known figures in the lumbering industry of the province, was 64 years of age at the time of his death. He has been connected with other lumber firms prior to his association with the Powell River Company.

Surviving are his widow and two sons.

Government Paper Bids

[FROM OUR REGULAR CORRESPONDENT]

Washington, D. C., September 22, 1937—The Government Printing Office has received the following bids for 100,000 pounds of supercalendered book paper in 38 inch rolls; Cauthorne Paper Company, 5.82 cents per pound; R. P. Andrews Paper Company, 5.82 cents; Paper Corp. of U. S., 5.74 cents; Stanford Paper Company, 5.82 cents; Whitaker Paper Company, 5.82 cents; Perkins-Goodwin Company, 5.82 cents; John F. Post, Inc., 6.3 cents; and Reese & Reese, Inc., 5.82 cents.

For 36,000 pounds (360,000 sheets) of No. 2 kraft wrapping paper; Barton, Duer & Koch Paper Company, 4.75 cents; Whitaker Paper Company, 4.65 cents; Stanford Paper Company, 5.5 cents; R. P. Andrews Paper Company, 4.655 cents; Reese & Reese, Inc., 4.41 cents; Paper Corp. of U. S., 4.75 cents; and Charles W. Beers & Company, 4.75 cents.

For 5,000 pounds of rope wood manila paper; Reese & Reese, Inc., 18 cents per pound; Whitaker Paper Company, 8.33 cents; R. P. Andrews Paper Company, 18 cents; and J. R. Howarth Paper Company, 12.75 cents.

Albert D. Merrill Gets Patent

[FROM OUR REGULAR CORRESPONDENT]

WATERTOWN, N. Y., September 20, 1937.—Albert D. Merrill, vice president of the Chemipulp Process Company, has been granted a patent for a chemical process to be used for digesting cellulosic material. It consists in forcing acid from a storage vessel into a digestion vessel by means of a steam injector. The injector consists of a pump used when the temperature of the acid has been raised to a predetermined degree.

Financial News of Pulp and Paper Industry

Union Bag To Split Stock 4 For 1 — Estimate Brown Taxes At Over $800,000 — New Group Is For Brown Co. Delay — Louisiana May Reduce Its Tax On Sulphur — Mead Corporation Income Up.

New York Stock Exchange

High, Low and Last for the Week Ending September 22, 1937

	High	Low	Last
A. P. W.	5¾	5⅛	5⅛
Armstrong Cork Co.	54	50	50½
Celotex Corp.	32	31	32
Celotex Corp., pf.	65	63	63
Certain-Teed Products Corp.	10⅛	9	9
Certain-Teed Products Corp., pf.	39½	35	37
Champion Paper & Fibre Co.	49	44	44
Champion Paper & Fibre Co., pf.	107½	107½	107½
Congoleum-Nairn Co.	34	31½	31½
Container Corp. of Amer.	23⅛	21⅛	21¾
Continental-Diamond Fibre Co.	14⅛	11¾	13
Crown Zellerbach Co.	18¾	17⅛	17¼
Crown Zellerbach Co., cum. pf.	91	90	90
Flintkote Co.	23½	20½	20¾
Robert Gair	9⅝	8	8¾
Robert Gair, pf.	31	31	31
International Paper & Power (New)	19⅛	17½	18¼
International Paper & Power (cv. pf. New)	68½	61	67
Johns-Manville Corp.	108	100⅛	105
Johns-Manville Corp., pf.	122	122	122
Kimberly-Clark Corp.	31½	30	31
MacAndrews & Forbes	31¼	30	30½
MacAndrews & Forbes, pf.	130½	130½	130½
Masonite Corp.	41¾	37	38
Mead Corp.	23	20½	23
Mead Corp., pf.	94	94	94
Paraffine Companies, Inc.	60	56	56
Paraffine Companies, Inc., pf.	99½	99½	99½
Ruberoid Co.	27	25⅛	26⅜
Scott Paper Co.	40½	39½	39¾
Sutherland Paper Co.	26⅜	26	26
Union Bag & Paper Corp.	18⅜	16	17
United Paperboard Co.	8⅛	7¼	7⅜
U. S. Gypsum Co.	92	81½	82½
U. S. Gypsum Co., pf.	159	158¼	159

New York Curb Exchange

High, Low and Last for the Week Ending September 22, 1937

	High	Low	Last
American Box Board Co.	14¾	14	14½
Brown Co., pf.	63	58	58
Great Northern Paper Co.	37	36	37
St. Lawrence	9½	9½	9½
St. Regis Paper Co.	6¼	5¼	5⅜
St. Regis Paper Co., pf.	97	90	90
Taggart Corp.	8½	7	7

Union Bag Approve 4-for-1 Stock Split

Stockholders of Union Bag and Paper Corporation at a special meeting last week approved a four-for-one split of the company's stock and authorized the issue of a principal amount of debentures not exceeding $10,000,000, of which $7,000,000 are to be offered shortly to stockholders in the form of convertible debentures, according to a statement issued by Alexander Calder, president.

Proceeds of the offering will be used principally to retire bank loans and all other debt incurred in the construction of the second and third units of the Savannah plant, according to the announcement. The second unit came into production in July of this year and the third unit is scheduled to start up about November 1. Application for registration of the new debentures under the Securities Act will be filed promptly with the Securities and Exchange Commission, Mr. Calder said.

"The management feels confident that the convertible feature of the debentures will result in the company being entirely free of funded debt, other than purchase money obligations, in the near future," Mr. Calder said.

Stockholders of the company also voted an increase in authorized capitalization from 300,000 shares to 1,500,000 in order to provide for the four-for-one split of the 263,860 shares presently outstanding, and also for the shares to be reserved for ultimate conversion of the debentures to be offered, plus a sufficient amount of authorized but unissued stock for future contingencies. Application for listing the stock resulting from the split-up has been approved by the Committee on Stock List of the New York Stock Exchange, it was announced.

Earnings of the company are currently running well ahead of a year ago, Mr. Calder stated. July profits were $153,253 while earnings for August are estimated at about $200,000. Including the August estimate, earnings for the first eight months this year were approximately $984,000, compared with a total of $387,391 earnings for the entire year, 1936.

Estimate Brown Taxes at Over $800,000

More than $800,000 in various municipal, state, federal and foreign taxes will be paid for the 1937 fiscal year by the Brown Company, New England's largest paper and pulp producers, it was estimated last week.

These taxes will be divided among 90 towns and cities, ten states, the United States government and at least eight foreign nations, with the lion's share, or more than fifty per cent, being paid in the State of New Hampshire.

Berlin, N. H., where the bulk of the $75,000,000 company's mills are located, will receive well over $325,000 in taxes, or about 47 per cent of the city's total revenues.

Indicating the wide distribution of the benefits accruing through the activity of the Brown Company, which is unable to fill orders for more than 100,000 tons of rayon, paper and other pulps, forty-four towns in Maine, 25 in New Hampshire, 17 in Vermont, two in Canada and two in Florida share in the taxes of the Brown Company, which recently filed a plan for reorganization with the U. S. District Court at Portland, Maine. States which benefit in these taxes are Maine, New Hampshire, Vermont, Florida, Massachusetts, Delaware, Illinois, Missouri, New York and California.

In addition to the United States and Canada, the Brown Company also pays taxes to Belgium, France, Finland, Great Britain, Italy, Norway and Sweden, mainly for protection of their more than 500 patents.

New Group for Brown Co. Delay

All major groups representing bonds and preferred stock of the Brown Company are unanimous in either recommending against the plan of reorganization as submitted by the company or of advising security holders to await publication of the survey now being made by the experts appointed by Judge Peters to examine the properties.

In a letter now being forwarded to holders of Brown Company bonds by the committee, of which

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Lee S. Buckingham of New York is chairman and of which Mayor Bergeron of Berlin, N. H., is a member, and which represents a large group of bondholders, the following comments are made:

"The reorganization plan as submitted by the company provides for the issuing of $6,500,000 of new Canadian bonds to be secured by the La Tuque properties, such bonds to rank equally with the $3,821,000 of old Canadian bonds which are pledged as security for the bonds presently outstanding. This would place existing bondholders in a subordinate position in respect to the mortgage on the Canadian properties."

For the time being the Buckingham committee does not advise bondholders to sign the green form which accompanied Mr. Brown's letter. "Complete freedom of action should be reserved until the details of this plan or any modified plan can be intelligently studied."

Similar conclusions have already been expressed by the bondholders' committee headed by Charles Francis Adams and by the preferred stockholders' committee of which Edward H. Osgood is chairman.

Grays Harbor To Offer Stock

Blyth & Co., Inc., announce that public offering will be made shortly of Grays Harbor Pulp and Paper Company $2 cumulative preferred stock to be convertible at any time on or before August 1, 1942, share for share into the company's common stock.

Blyth & Co. says that the Grays Harbor Pulp and Paper Company of San Francisco is engaged principally in producing a special type of bleached sulphite pulp known as Rayonier, used in the manufacture of rayon and cellophane, and ordinary grades of bleached sulphite pulp. The amount of the contemplated offering has not yet been determined. It will represent the unsubscribed balance of 153,739 shares of the $2 cumulative preferred stock offered to common stockholders, whose rights to subscribe expire today.

On August 21, the company made an offer to holders of $8 preferred stock to exchange their shares as of August 1 on the basis of 4½ shares of $2 cumulative preferred stock for each share of $8 preferred stock. A total of 70,633½ shares of $2 cumulative preferred stock was accepted on this offer in exchange. The company intends to pay all accrued dividends on its outstanding $8 preferred stock and to retire or redeem all such $8 preferred stock and all existing indebtedness in the amount of approximately $3,000,000 with the proceeds of this financing.

Upon completion the company will have outstanding approximately 234,000 shares of $2 cumulative preferred and 326,214 shares of common stock.

Louisiana May Reduce Sulphur Tax

Intimation that official action in response to growing public sentiment may soon be taken in Louisiana to relieve the existing tax burdens on the state's sulphur industries was given today by A. B. Patterson, chairman of the State Board of the Department of Industry and Commerce, in a letter to Langbourne M. Williams, Jr., president of the Freeport Sulphur Company.

The State Board of the Department of Commerce and Industry was created last April by the Louisiana legislature as an official organ for the purpose of stimulating the industrial progress of the state.

Mr. Patterson's letter was a formal request that the company consider resumption of its $300,000 construction program at Port Sulphur and restoration of production to levels achieved prior to July, 1936, when the state severance tax on sulphur was hiked to $2 a ton from 60 cents.

Output of sulphur in Louisiana was reduced 23 per cent after the $2 tax rate became effective last year, as compared with an increase of 37 per cent in Texas. Lowering of the Louisiana tax, however, would automatically result, it is believed, in a higher rate of production approximating that which prevailed at the time the tax was increased.

Mead Corp. Increases Income

The report of the Mead Corporation, for the thirty-six weeks ended on September 4, shows a net profit of $1,584,631, after depreciation, interest and taxes on funded debt and other deductions. This is equivalent to $2.19 a share on 619,374 shares of common stock outstanding at the end of this period, after allowance for preferred dividends. It compares with a net profit of $558,798, or 72 cents a share on 586,210 common shares, after preferred dividend requirements, for the thirty-six weeks ended September 5, 1936.

For the twelve weeks ended on September 4, the company reports a net profit of $427,062, which is equal, after dividend requirements on the preferred, to 52 cents a share on the same number of outstanding common shares, compared with a net profit of $154,182, or 19 cents a common share, after preferred dividends, for the corresponding period last year.

These figures cover Dill & Collins, Inc., from June 13, 1936, which was not consolidated in previously published statements for corresponding periods in 1936.

Seek Reductions on Valuations

[FROM OUR REGULAR CORRESPONDENT]

WATERTOWN, N. Y., September 20, 1937.—Several prominent paper mill concerns in this section are seeking reductions on property valuations claiming that existing assessments are excessive. The Robert Gair Company which recently purchased the property of the Hinde-Dauch Paper Company, is seeking a reduction in its assessment from $54,000 to $25,000. Practically all of the buildings on the property except an old warehouse have been demolished. The property was only recently reduced from $60,000 to $54,000 but a further reduction is sought. A revision on property owned by Taggart Brothers Company is also sought, the concern claiming the valuation is high. The property is assessed for $12,000 and the concern asks for a reduction to $5,000. The Sherman Paper Company contends that its mill property and water rights in the town of Champion are taxed from 150 to 200 per cent too much and has started certiorari proceedings for a review of the assessments. Among the parcels of property involved are the paper mill, which is assessed at $90,000, the one-half of dam and water rights assessed at $46,200 and the railroad siding and switch assessed at $4,250. Officials have protested the assessments declaring them excessive and illegal but the valuations were not lowered.

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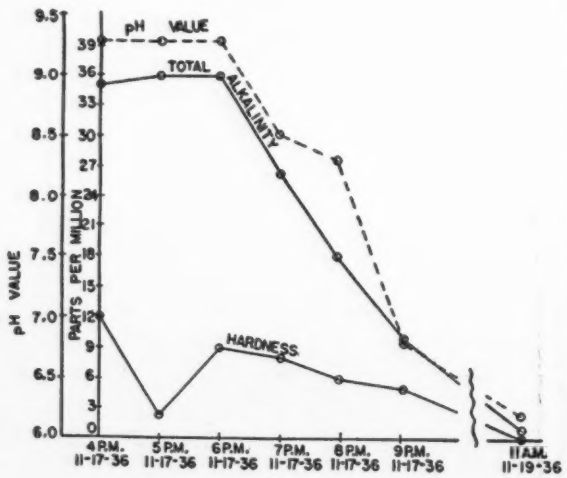
Boiler Water Treated to Prevent Carry Over

By John J. Maguire[1] and John T. Topolosky[2]

With the ever increasing trend toward higher standards in modern power plant operation, factors which may have been of minor importance under less exacting conditions assume the status of major problems. Entrainment of solids with the steam, the causes and methods of prevention of such entrainment are definitely factors of major importance which are better understood today than a few years previously. The physicochemical theory of foam advanced by Foulk[3] has served as a basis for a considerable amount of recent research work. The formation of liquid films is dependent upon difference in concentration between the surface layer of the liquid and the mass of the liquid. Concentration of dissolved matter in the surface of the liquid is termed positive absorption and the receding of dissolved matter from the surface is termed negative absorption. Effect of organic matter in boiler water foaming has been shown by Behrman,[4] who found removal of organic matter materially decreased tendency of water to foam. Similar results were obtained by Hancock.[5]

Severe carry over was being experienced in a large New England industrial plant resulting in the repeated burning out of superheater tubes. The temperature of the superheated steam had dropped considerably below the design temperature as a result of carry over. As is common with New England water supplies, this water is quite low in hardness and general solids content and is ideal for boiler feed purposes with the exception of the high content of organic matter. Organic concentrations in the raw supply generally reach a peak during the autumn and the greatest difficulties with carry over result during this season.

[1] Chemical Engineer, W. H. & L. D. Betz.
[2] Steam Engineer, St. Croix Paper Co.
[3] Foulk, Ind. and Eng. Chem., 21, 160 (1929).
[4] Behrman, Ibid., 21, 817 (1929).
[5] Hancock, J. Soc. Chem. Ind., 49, 369 (1930).



Solids content of condensed saturated steam

Solids carried with the steam into the superheater may be expected to deposit and, over a period of time, gradually build up scale which could cause superheater tube failure through its heat insulating qualities. It was evident, however, that plant difficulties from superheater tube failures were not primarily due to scale formation. Several superheater tubes failed after only one week of installation and upon examination showed clean internal surfaces with evidence of failure from overheating. Under these circumstances the theory was evolved that the unusually high organic concentrations of the boiler water were giving rise to an actual carry over of foam from the boiler. This foam entering the superheater tubes was short-circuiting steam passage and causing actual steam starvation of certain tubes. Resultant overheating of these tubes caused their failure with no appreciable amount of scale present.

Boiler Data

The boiler was rated at 745 hp. and operated at 450 lb. pressure. Steam production varied from 90,000 lb. per. hr. to 120,000 lb. per hr. with an average boiler rating of 500 percent. The boiler was a three drum, bent tube type equipped with water walls, air preheater, economizer and superheater. Feedwater conditioning was effected through the use of phosphate and sodium hydroxide under competent supervision. Soluble phosphate was maintained in the boiler water in the required amount with hydrate alkalinity within proper limits. Boiler water was tested six times daily and tests reported to supervisory laboratory regularly.

Although the boiler had been refilled with fresh water after having been off line for replacement of superheater tubes, a complete survey of conditions by the authors made only two days later showed the condensed steam obtained between the boiler drum and superheater inlet to represent a heavy carry over condition. Samples showed high turbidity and solids content. Analyses of condensed steam obtained at 10:30 a. m. and 1:30 p. m. are shown in Table I. This continued severe carry over was obtained in spite of the fact that while excess phosphate was maintained as usual, no caustic had been added to the boiler water and the boiler had been blown down every 2 hours during the two-day period following refilling the boiler with fresh water.

From a careful consideration of the analytical data and plant characteristics, it was evident that the effect of organic concentrations and present system of treatment in increasing foaming tendencies of the boiler water must be eliminated This was necessary to stop the carry over and prevent the frequent plant shutdowns resulting from the failure of superheater tubes. Various organic reagents employed to date at the plant for feedwater conditioning had failed entirely in this respect as was to be expected since their properties were not adapted to such action. This difficulty with carry over of solids in the steam was not due to

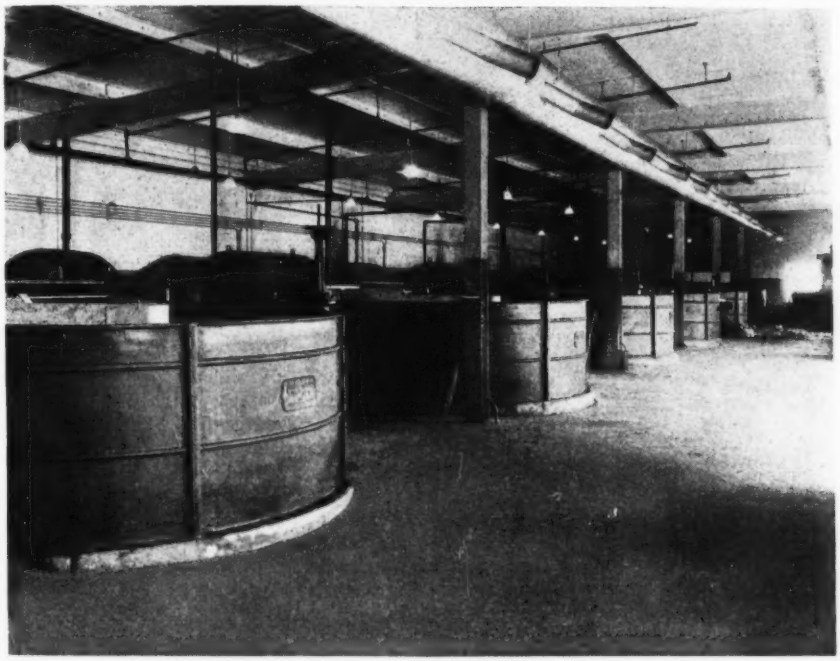


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TABLE I.—CONDENSED SATURATED STEAM, NOVEMBER 17, 1936

Time	10:30 a.m.	1:30 p.m.	4:00 p.m.	5:00 p.m.	6:00 p.m.	7:00 p.m.	7:55 p.m.	9:10 p.m.
Parts per Million								
Hardness as ($CaCO_3$)	12	10	12	2	9	8	6	5
Sulfates as (SO_4)	10	8						
Chlorides as (Cl)	3	2	2	6	2	0	4	3
Bicarbonates as ($CaCO_3$)	18	14	11	16	16	14	14	10
Carbonates as ($CaCO_3$)	30	12	24	20	20	12	4	0
Hydrates as ($CaCO_3$)	0	0	0	0	0	0	0	0
pH Value	9.3	9.3	9.3	9.3	9.3	8.5	8.3	6.7

high concentrations of suspended solids in the boiler water nor by the maintenance of high boiler alkalinities. Dissolved solids concentration was also a factor that influenced this carry over very little. The normal cause for a carry over condition can usually be found in any one of these factors or a combination of them. The direct cause of these conditions, however, was the high organic concentration of the boiler water. Tests upon the relative organic concentration of the feed and boiler waters indicated the concentration of organic matter in the boiler water was in direct ratio with the concentration of other salts and that no material precipitation of this organic matter was being effected in the boiler under the action of heat and pressure. This was further shown by the samples of boiler water which showed low suspended solids concentration and required coagulation of the colloidally dispersed organic matter in order to clarify the water for colorimetric analysis.

Statement of Boiler Water Problem

The problem in the elimination of the carry over condition therefore hinged upon a coagulation of the organic matter which was present in the boiler as well as the feedwater in the colloidal state. Various strong electrolytes such as hydrochloric, sulfuric and nitric acid employed experimentally in the laboratory resulted in coagulation of organic matter from boiler water samples and the precipitation of this organic matter in a floc that could easily be filtered. Potassium nitrate and similar salts tested also exhibited this "salting-out" effect, although to a lesser degree. Quantities of these inorganic agents necessary to effect coagulation were so large as to preclude any possibility of their use in the treatment of the boiler water. A formulation of a reactive organic colloid was accordingly employed for this purpose on the basis of mutual coagulation of oppositely charged colloidal particles.[8, 9]

Table I shows the analysis of the condensed saturated steam obtained at different periods of the day on which treatment was started. The high solids content of the first few samples will be noted. At 4:00 p. m. the feed of a reactive organic colloid was started and this material was fed continuously to the boiler. An analysis of the condensed steam obtained at 4:00 p. m. showed the same characteristics observed on earlier samples. No improvement was noted on samples obtained at 5:00 p. m. and 6:00 p. m. The sample at 7:00 p. m. showed some reduction in solids together with a drop in pH value from 9.3 to 8.5. This sample, however, showed the characteristic marked turbidity of previous samples. A further slight decrease in the solids content was observed on the steam sample collected at 7:55 p. m. The pH value showed a further slight decrease to 8.3.

[8] Linder and Picton, J. Chem. Soc., 71, 586 (1897).

The sample of condensed steam obtained at 9:10 p. m. gave visual evidence of material improvement. This sample was of excellent clarity and showed no trace of colloidal organic matter formerly carried over from the boiler. An analysis of this sample revealed a very marked decrease in solids content, together with the entire elimination of carbonate alkalinity. The pH value had decreased to 6.7. The gradual improvement in the quality of the condensed steam can be noted from the chart.

Thus, in the course of 5 hr. the heavy carry over of solids with the steam had been eliminated and a steam of relatively high purity produced through the application of the proper treatment. During this time no feedwater conditions with the exception of the introduction of a reactive organic colloid in the boiler feedwater.

An interesting fact in connection with the gradual decrease in the solids content of the condensate was that an increase in the temperature of the superheated steam was noted from the recorders even before any improvement was observed in the analysis of the condensed steam. Naturally, as the moisture content of the steam delivered to the superheaters decreased, the heat which previously had been applied to the evaporation of the drops of boiler water carried into the superheaters, was now free to increase the temperature of the steam. The superheated steam temperature showed a gradual increase during the time that chemical analyses of the steam showed a gradual reduction in solids.

Boiler Water Concentrations

The next step was to so raise boiler water concentrations from their present low level to a point where they would represent entirely average conditions. At the same time, the condensed steam should be continuously analyzed so as to note any possible change in steam purity due to increased boiler water concentrations. Accordingly, sufficient sodium hydroxide and sodium sulfate were added to the boiler water to quickly restore concentrations to the values maintained at the time when water conditions were normal and organic concentrations of the feedwater not excessive. Since boiler water concentrations were quite low, this procedure necessitated a heavy charge of these materials. Such a slug of treatment would result in conditions favorable to the production of carry over and would consequently afford a good test of the efficacy of the treatment. Reactive colloid was fed continuously during this period.

Analyses of the boiler water made on the following day, November 18, 1936, showed increasing concentrations with the boiler sample obtained at 7:30 a. m. on November 19, illustrating concentrations as high as would be maintained under proper operating conditions. On November 18, condensate samples were obtained from 9:00 a. m. to 4:30 p. m. and analyzed at 10 and 15 min. intervals to secure a con-

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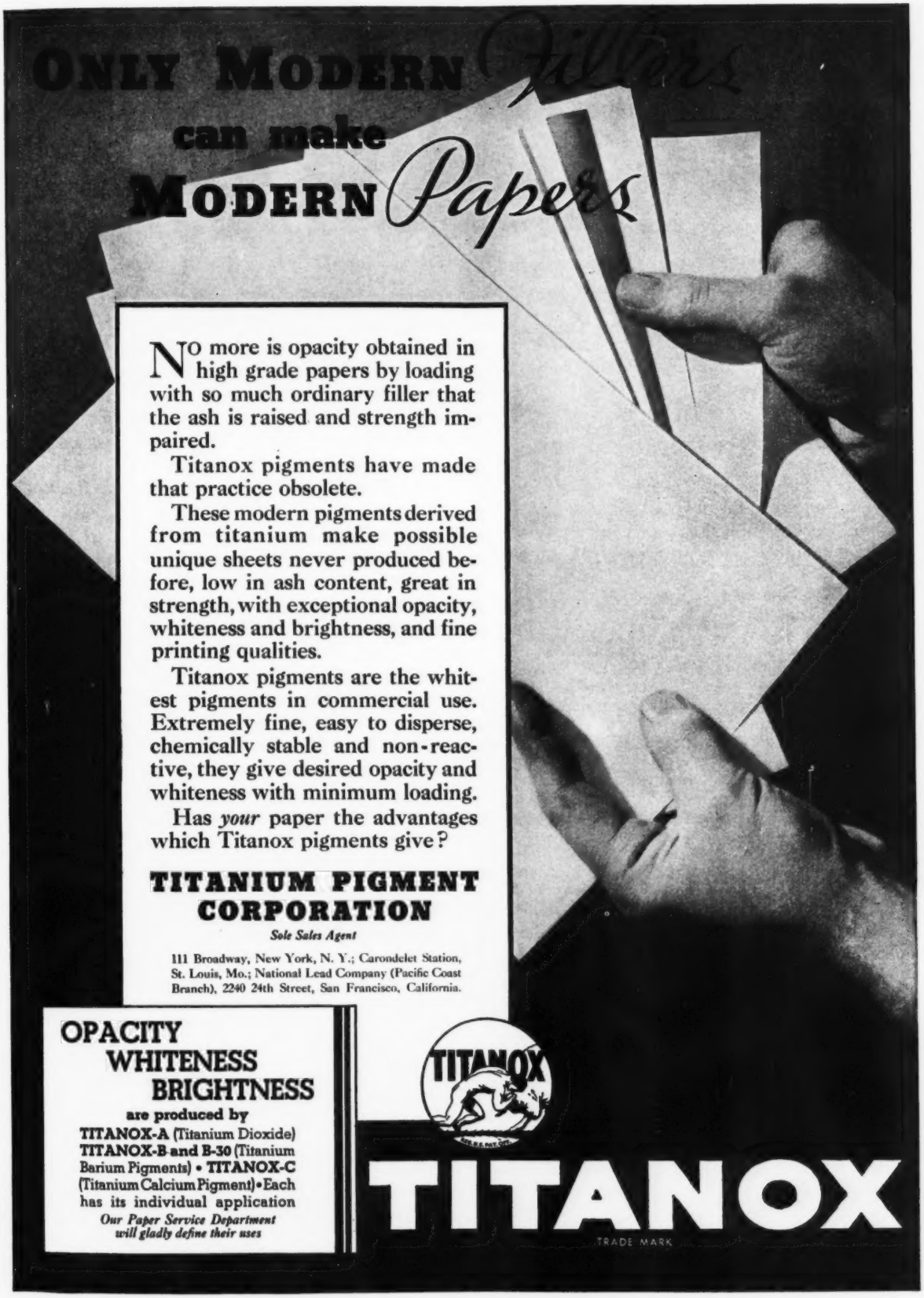

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TABLE II.—CONDENSED SATURATED STEAM AFTER STUDY

Date		11-26-36	12-2-36	12-9-36	12-15-36	12-30-36	1-14-37
Analysis No.		L 254	L 561	L 806	L 1187	A 419	A 1084
Observation		Sl. Turbid	Clear	Clear	Sl. Turbid	Clear	Clear
Suspended Matter	Parts Per Million	Trace	None	None	Trace	None	None
Organic Matter		Trace	None	None	Trace	None	None
Total Hardness as ($CaCO_3$)		0	4	0	0	0	0
Reaction		Sl. Acid	Sl. Acid	Sl. Acid	Sl. Acid	Sl. Acid	Sl. Acid
Sulfates as (SO_4)		0	0	0	0	0	0
Chlorides as (Cl)		0	0	0	0	0	0
Iron as (Fe)		None	None	None	None	None	None
Free Carbon Dioxide		8	8	3.3	4	2.7	9.6
Bicarbonates as ($CaCO_3$)		8	8	8	4	8	6
Carbonates as ($CaCO_3$)		0	0	0	0	0	0
Hydrates as ($CaCO_3$)		0	0	0	0	0	0
pH Value		6.3	6.3	6.7	6.1	6.3	6.1

tinuous analysis of the condensed steam. Thirty condensate samples were analyzed this day showing a general average of 4 parts per million bicarbonate alkalinity and a pH value of 6.7. Samples continued free of turbidity.

A sample of condensed steam obtained at 11:00 a. m. the following day, November 19, and submitted to a complete laboratory analysis showed hardness, sulfates and chlorides as zero. Bicarbonates were present as but 2 parts per million, with free carbon dioxide as 2.5 parts per million and a pH value of 6.2. This steam sample was of exceptional purity and as pure as the distilled water in use at the plant. It was evident at this time that difficulties with carry over had been eliminated and that a steam of high quality was being produced from the boiler.

Colloidal Treatment Employed

This elimination of entrained solids was accomplished through the use of a reactive organic colloid formulated specifically for these conditions. The colloid employed was of the laminaric acid series and consisted of a mixture of laminaria stenophyllia and laminaria digitata. It was hydrophilic (water loving) in nature and had been peptized to have a particle size in a colloidal range from 1 to 100 millimicrons. The colloid was fed to the boiler feedwater in the form of the sodium sol with a multiplicity of negative charges carried on the micell. It is postulated that mutual coagulation with positively charged organic matter already present resulted in a precipitation,[7] lowering the organic matter concentration in the liquid film and reducing its effect in increasing the tendency of solids to carry over with the steam. The reaction taking place between the negatively charged organic colloid used for feedwater conditioning and the organic matter present in the boiler water does not proceed in stoichiometric proportions, but is entirely a colloidal reaction dependent upon the neutralization of the electrolytic charges carried by the colloidal particles. Pectization (the precipitation of a sol) results in the formation of a precipitated gel exposing a vast surface area for the absorption of both suspended and dissolved solids.[8] The gelatinous precipitate formed possesses no crystalline structure and is analogous to the gels formed in similar reactions with calcium magnesium and other polyvalent positive ions.[9] Effect of suspended phosphate precipitates on film stabilization was reduced by the absorbing action of the gel floc. Niehaus[10] states the maximum stabilizing power is exhibited by particles between colloidal and gross dispersion and recommends maintenance of soluble phosphate below 15 to 20 parts per million. The removal of finely divided crystalline precipitates from the liquid film prevented their stabilization of the foam produced and naturally resulted in the production of a purer steam. Due to the vast number of negative charges carried on the colloid micell in comparison with the single or double charges carried on inorganic ions experimented with, a high reactive ratio was obtained and it is necessary to use but a relatively small quantity of material to obtain the desired results.

The quality of the steam obtained during this study has been maintained since that time. Table II shows the analysis of the condensed saturated steam samples obtained over several weeks' time and submitted to a laboratory analysis. Daily tests are also made on the steam at the plant to check upon its purity. During this time, blow down has been maintained between 1.0 and 1.5 per cent.

Rise in Steam Temperature

It has previously been mentioned that as a reduction in carry over was affected, an increase was noted in the temperature of the superheated steam. Average superheated steam temperature previous to our study was 590 deg. F. An increase of 50 deg. F. was observed during the first three days following application of colloidal treatment. A further increase of 20 deg. F. was effected within a week. Present average superheated steam temperature is 660 deg. F., representing an increase of 70 deg. F. Although the aggravated difficulties with superheater tubes have been due to an unusually high organic concentration in the feedwater, a certain amount of carry over had been taking place even when these unusual conditions were not present. The reduction in superheated steam temperature due to this factor has been eliminated. Increased steam temperature resulted in an improvement in operating efficiency and in comparison with the frequent plant shut-downs formerly necessitated, it has not been necessary to replace a single superheater tube following this change in feedwater conditioning.

While this problem consisted in the elimination of carry over due primarily to the high organic concentrations of the boiler water under a straight crystalline method of treatment, the method of attack employed lends itself readily to the solution of other problems with carry over which may not necessarily be due to the particular factors covered in this instance. Application of sound principles and the knowledge gained from previous problems together with the use of the various treatments available provide engineers with the necessary tools with which to obtain similar results wherever carry over is a problem.

[7] Thomas, A. W. "Colloid Chemistry," McGraw-Hill Book Co. (1934).
[8] Alexander, J. "Colloid Chemistry," Vol. I, Chemical Catalog Co. (1926).
[9] Betz, L. D., and Sheen, R. T. Combustion, May (1936).
[10] Niehaus. Vom Wasser IV, p. 140 (1930).

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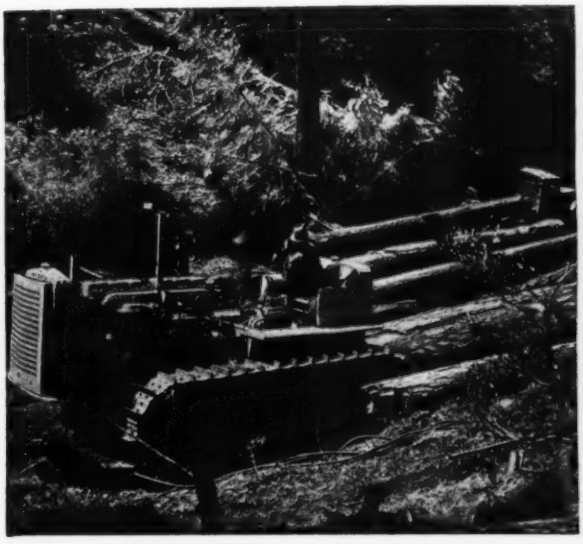

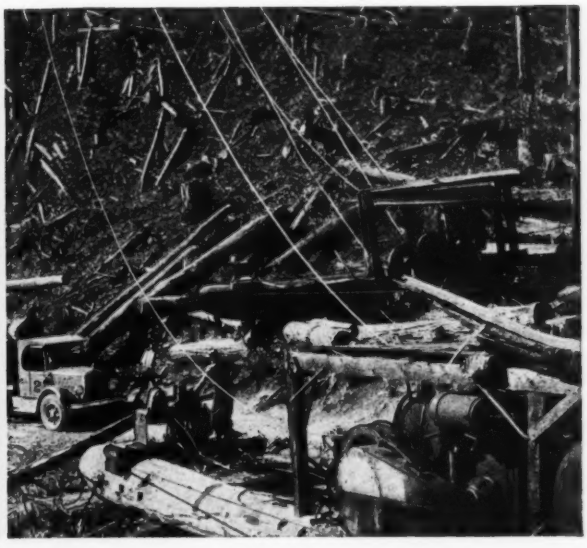

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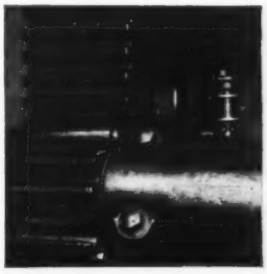

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You are invited to visit our exhibit at the TAPPI Convention, Savannah, Ga., October 18th, 19th, 20th, 1937

CONSTRUCTION NEWS

A Summary of Vital Facts Regarding Construction, and Operation of Pulp and Paper Mills

General Construction News

Lufkin, Tex.—The Southland Paper Mills, Inc., care of Wirt Davis, chairman of the board of directors, Republic National Bank, Republic Bank Building, Dallas, Tex., organized several months ago, has plans maturing for new newsprint mill in vicinity of Lufkin, where site is being secured. Plant will consist of group of one and multi-story units, to be equipped for a capacity of about 50,000 tons of newsprint per annum, with power house, machine shop, pumping station and other mechanical departments. It is estimated to cost approximately $5,000,000. At a recent meeting of the Texas Newspaper Publishers' Association at Galveston, Tex., subscriptions to company stock totaling $250,000 were made, and a large part of output of mill will be used for dailies of members of that organization. Additional sales of stock are being made to assure funds for construction of mill and initial operations. New company also has arranged for lease of pine timberlands for source of raw pulpwood. E. L. Jurth, president, Angelina County Lumber Company, Lufkin, is an official of Southland company, and active in project. As previously noted in these columns, the Perkins-Goodwin Company, 30 Rockefeller Plaza, New York, N. Y., is interested in project and will be prominent in the management of the new mill.

Bellingham, Wash.—The Puget Sound Pulp and Timber Company, Army street, has awarded contract to the Industrial Engineers, Inc., Tacoma, Wash., for a new dock on waterfront near mill, to be 80 feet wide and 800 feet long, and will be used for pulpwood shipments, with mechanical-handling equipment installation for such purpose. Work will be placed under way at once. This is part of the large expansion program to be carried out at this mill, recently noted in these columns, and for which plans are now maturing, to include construction of several large units, equipped for a capacity of about 40,000 tons per annum, giving the plant a total output of 100,000 tons yearly. Project will represent a total investment of $2,600,000, and financing has been arranged in that amount. The Bellingham Water Department has plans under way for installation of a new 24-inch steel pipe line in State street, leading to mill site, for additional water supply for plant. It is estimated to cost close to $60,000. Ralph M. Roberg is general manager of the Puget Sound company.

New York, N. Y.—The American Can Company, 230 Park avenue, has plans for large increase in fiber container-manufacturing division, with installation of equipment in different plants to double present capacity, which is close to 3,000,000 containers per week. The containers are used primarily for milk service. Work is scheduled to be placed under way soon.

Niagara Falls, N. Y.—The Gilman Fanfold Corporation, Ltd., Buffalo avenue and Tenth street, manufacturer of paper specialties, affiliated with the Moore Corporation, Ltd., 330 University avenue, Toronto, Ont., has awarded general contract to the Austin Company, 16112 Euclid avenue, Cleveland, Ohio, for new one-story addition, recently referred to in these columns, and will proceed with superstructure at once. It is estimated to cost close to $50,000, with equipment. E. G. Baker is president.

West Springfield, Mass.—The General Fibre Box Company, Circuit avenue, West Springfield, manufacturer of corrugated fiber boxes and containers, has plans for several new one-story additions to plant, including new shop unit and boiler house. Bids will be asked soon on general erection contract. Cost reported over $40,000, including equipment. McClintock & Craig, 458 Bridge street, Springfield, are architects and engineers.

High Point, N. C.—The Price Paper Box Company, recently organized by William Price, vice-president, Carolina Paper Box Company, Webb avenue, Burlington, N. C., and associates, has taken over building formerly occupied by the Lock-Knit Hosiery Mills Company, West Green street, High Point, and will use for new plant. Improvements will be made in building at once and equipment installed for large capacity. It is expected to have the new plant ready for service in October.

New Brunswick, N. J.—Ferodo & Asbestos, Inc., Codwise avenue, a subsidiary of the Keasbey & Mattison Company, Ambler, Pa., manufacturer of asbestos mill board products, asbestos paper, etc., has awarded general erection contract to the Austin Company, 16112 Euclid avenue, Cleveland, Ohio, and 19 Rector street, New York, N. Y., for new addition to plant, recently referred to in these columns. It will be one and two-story, 90 x 500 feet, estimated to cost over $350,000, with equipment. Work will be placed under way at once.

New York, N. Y.—The Papyrus Papeteries, Inc., 200 Fifth avenue, paper products, has leased space in building at 3-7 West 29th street, and will occupy for storage and distribution, and office service.

Trenton, N. J.—The Panelyte Corporation, North Enterprise avenue, manufacturer of insulating board and kindred paper board products, has completed erection of new addition to mill, comprising a one and two-story structure, 50 x 350 feet, arranged with overhead lighting by sawtooth roof type of con-

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Paper Rolls	Granite Press Rolls	Embossing Calenders	Stock Cutters
Embossing Rolls	Glassine Supercalenders	Mullen Paper Testers	Paper Dampeners
	Web Supercalenders	Tensile Testers	

struction. New unit represents an investment of about $70,000, as previously noted in these columns, and will be used for large increased production. Newton A. K. Bugbee & Company, Inc., 206 East Hanover street, Trenton, is general contractor. Plans were drawn by William W. Slack & Sons, 1401 West State street, Trenton, architects. Company is a subsidiary of the St. Regis Paper Company, 230 Park avenue, New York, N. Y.

Pearisburg, Va.—The American Cellulose and Chemical Manufacturing Company, Ltd., 180 Madison avenue, New York, N. Y., affiliated with the Celanese Corporation of American, Inc., same address, is beginning preliminary work for proposed new cellulose rayon mill on tract of 1200 acres of land in Giles County, Va., vicinity of Pearisburg, recently acquired, as previously noted in these columns. Site is being staked out and foundations for initial units will be placed under way soon. Plant will consist of large group of one and multi-story units, with pumping station, power house and other mechanical buildings and will cost in excess of $5,000,000, with machinery. C. F. Beran is consulting engineer for company; E. T. Small at mill of Celanese Corporation, Amcelle, near Cumberland, Md., is designing engineer.

Toronto, Ont.—The Reg. N. Boxer Company, Ltd., Birmingham street, near Seventh street, New Toronto, has completed plans for new one-story addition to mill, for which superstructure will be placed under way at once. It is estimated to cost over $35,000, with equipment.

New Companies, Etc.

Brooklyn, N. Y.—The Marcy Paper Box Company, Inc., has been chartered with capital of 200 shares of stock, no par value, to manufacture paper boxes and containers. It is represented by Saul Pulver, 225 West Thirty-fourth street, New York, attorney.

Chicago, Ill.—The American Pulp Products Corporation, 100 North LaSalle street, has been incorporated with capital of 10,000 shares of stock, no par value, to manufacture and deal in pulp products. The incorporators include E. L. Bender, S. Brenner and A. Lanphere.

Jersey City, N. J.—The American Pulp Corporation, 15 Exchange place, has filed a petition in bankruptcy in the Federal Court, listing liabilities at $27,529.61, and assets, $16,864.93.

New York, N. Y.—The Tardic Paper Stock Company, Inc., has been organized with capital of $10,000, to deal in waste paper. New company is represented by Louis L. Archer, 232 Broadway, attorney.

Schroon River Makes Improvements

[FROM OUR REGULAR CORRESPONDENT]

WARRENSBURG, N. Y., Sept. 20, 1937.—Improvements and repairs have been made in progress at the Schroon River Paper and Pulp Company for some time past, the concern taking advantage of the low water in the river. Employees have been making the repairs to various parts of the mill. Operations are to be started at full blast as soon as the river rises as it is reported that the company has many orders to be filled. Since its recent reorganization the company has operated on a smooth scale and orders have resulted in overtime schedules for some time.

Close Case Against Corrugated Container

Washington, D. C., September 22, 1937—The Federal Trade Commission has closed its case against Corrugated Container Corporation, 230 Third avenue, Brooklyn, engaged in the manufacture and sale of corrugated fiber boxes, for the reason that the company has entered into a stipulation to discontinue the unfair method of competition alleged in a complaint issued by the Commission.

The complaint charged the company with placing upon its boxes a stamp which was not the usual and official certification, required by rules adopted by the official classification committee of railroad companies, setting forth the bursting test, dimensions and gross weight of corrugated fiber boxes. According to the stipulation, the stamp used by the respondent company on its boxes so closely simulated the official stamp in shape and general appearance as to cause railroads and purchasers to accept such boxes in the belief that they bore the official certification and complied fully with construction requirements.

The company agreed to cease stamping its corrugated fiber boxes in any manner so as to imply that they bear the official stamp of compliance and meet the construction requirements embodied in the railroad companies' rules, which are on file with the Interstate Commerce Commission.

In closing the case the Commission reserved the right to reopen it should the facts so warrant.

Newsprint Production Increases

Production of newsprint in Canada during August 1937 amounted to 318,713 tons and shipments to 313,435 tons, according to the News Print Service Bureau. Production in the United States was 80,311 tons and shipments 75,724 tons, making a total United States and Canadian newsprint production of 399,024 tons and shipments of 389,159 tons. During August 30,519 tons of newsprint were made in Newfoundland, so that the total North American production for the month amounted to 429,543 tons. Total production in August 1936 was 374,002 tons.

The Canadian mills produced 383,507 tons more in the first eight months of 1937 than in the first eight months of 1936, which was an increase of eighteen and nine tenths per cent. The output in the United States was 20,725 tons or three and four tenths per cent more than in the first eight months of 1936, and in Newfoundland 26,500 tons or twelve and four tenths per cent more, making a total increase of 430,732 tons, or fifteen and one tenth per cent.

Stocks of newsprint paper at Canadian mills were reported at 85,256 tons at the end of August and 17,676 tons at United States mills, making a combined total of 102,932 tons compared with 93,067 tons on July 31, 1937.

Pulpwood Co. Increases Directorate

APPLETON, Wis., Sept. 20, 1937.—An amendment has been filed to the articles of incorporation of the Pulpwood Company, Neenah, Wis., increasing the number of directors to five. The amendment was voted recently at a meeting of the officers of the Kimberly-Clark Corporation. Signers of the amendment were F. J. Sensenbrenner, president, and C. H. Sage, secretary.

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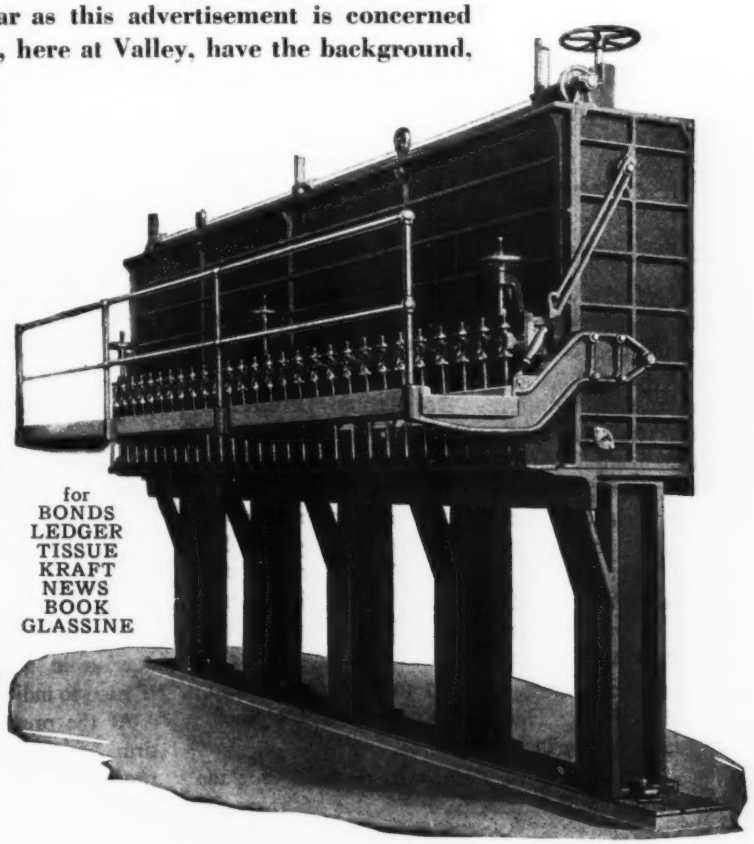

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Vol. CV New York, September 23, 1937 No. 13

COMING EVENTS IN THE PAPER INDUSTRY

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY—Fall Convention, DeSoto Hotel, Savannah, Ga., Oct. 18-20, 1937.

NEW ENGLAND SECTION, Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Nonotuck Hotel, Holyoke, Mass.

DELAWARE VALLEY SECTION, Technical Association of the Pulp and Paper Industry—Second Friday of each month at the Engineers Club, Philadelphia, Pa.

LAKE STATES SECTION, Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

KALAMAZOO VALLEY SECTION, Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park-American Hotel, Kalamazoo, Mich.

UNEMPLOYMENT—A NEW APPROACH

"Some 67,000 new manufacturing plants will be needed to provide jobs for available factory labor," according to a recent study by Allen W. Rucker and N. W. Pickering, business economists. The study, "WHAT CAN INDUSTRY DO ABOUT UNEMPLOYMENT?" has just been published by Farrel-Birmingham Company, Inc., Ansonia, Conn., in booklet form. "Factory employment opportunity since 1923 has risen and fallen directly with the number of going businesses; the job opportunity per going firm has ranged from 42 to 44 persons. The present average, 43.7 employees per plant, would require 67,000 new plants to provide employment for the ten million workers available to industry."

The authors stress the need for concrete thinking by business men. They point out that available official records show that:

"To produce the 1929 standard of living for the 1937-38 population, industry will need to raise the total work done from the present 13.3 billion man-hours a year to 18.65 billion man-hours; that this in turn means an average work-year per wage earner of 1865 man-hours instead of the 1704 hours worked in 1935, for each of ten million wage earners.

"To employ ten million wage earners in industry means one and one-half million new jobs and these can be provided only by an additional 67,000 new firms inasmuch as the census reveals that jobs per going firm do not show any appreciable increase in fifteen years."

The study points out that an adequate standard of living for the underprivileged part of the population would require either some 5 billion man-hours of work additional in industry or, lacking that, an increase of 54 per cent in the productivity per man-hour. Unless more goods are produced, no possible increase in dollar wages will raise the real standard of living, say the authors. Their figures take into consideration the increase in productive efficiency.

The authors believe that the floundering of social and political thought during the past four years strengthens the conviction that any utimate solution of the unemployment problem will devolve upon business management; and be dependent upon the crystallization of not only concrete objectives but specific requirements which must be fulfilled in order to attain those objectives.

The unfortunate contradiction of schemes and plans current today the study asserts is largely traceable to the fact that the specifications for realizing a solution of the problem have never been expressed in exact, quantitative terms. The nation has been led up and down an economic wilderness for four years with no ideas of precisely what must be done to reach the Promised Land and, hence, no way practically to develop the necessary methods of doing it.

That condition, at least, may be corrected by pooling of businesslike thinking and the preliminary statement of objectives, requirements and alternative methods of meeting the requirements in specific terms. Subject to the limitations of data and present knowledge, as well as those of space here, the authors offer the following as a starting point:

To create conditions which will make available one and one-half million new job opportunities in manufacturing industry;

To increase production to the point where 1929 standard of living may be provided for 1937-1938 population;

To so distribute the work opportunity that wage earners will automatically share in industrial production in accord with natural law, i. e., in proportion to individual skill and merit.

At the present employment opportunity per going firm of 43.7 persons, the first requirement is the promotion of conditions of business profitableness necessary to stimulate the formation of some 67,000 new manufacturing enterprises;

At current levels of productive efficiency, there are needed 18.65 billion man-hours of work for the production of goods necessary to a 1929 living standard for 1937-1938 population; and that total when attained, ought to be steadily expanded;

That, in turn, calls for an average of 1,865 hours

of work annually for ten million wage earners, an increase (not a reduction) from the level now prevailing, 1,704 man-hours per annum.

Within the limitations upon industrial payrolls set by the rise and fall of farm income, two methods are available as alternatives:

(a) At the present level of farm income and hence of payrolls, industry can give 18.65 billion hours work only if the average hourly wage rate is deflated to 48.2 cents; or,

(b) To support the present level of wage rates, some 66 cents per hour average, it will be required that farm income be inflated some 37 per cent in order to generate the $12.31 billions needed for the industrial payroll.

No attempt can be made in the study the authors state to insist upon any one course of action; the discussion is primarily offered for its possible value in stimulating the serious consideration of business toward the crystallization of objectives, requirements for fulfilling them and methods of attack. For it is certain that if management can eventually arrive at a common accord on these matters, the solution of the problem will not long thereafter be delayed.

In concluding the study it is stated that discussion is invited, with constructive contribution toward these ends. For, as once so forcefully put by Abraham Lincoln, "If we first know where we are and whither we are tending, we can then tell better what to do and how best to do it."

Powell River Makes New Agreement

VANCOUVER, B. C., September 18, 1937—Copies of agreement reached between representatives of the Powell River Company and Pacific Mills Ltd., and representatives of the recently formed local chapters of the American Federation of Labor are now in circulation for study and consideration by workers at the Powell River and Ocean Falls plants of the two companies. Under the terms of the new agreement wages are stepped up to the same level as the last adjustment made in the Ontario Mills of the Abitibi Power and Paper Company, which union officials state, place the two B. C. plants on a wage scale corresponding to that recognized as the highest in effect in any Canadian Paper mills. The agreement was reached at a conference between union and company representatives in Vancouver recently.

Under terms of the new agreement wage increases are made retroactive to June 1 last, providing for a basic hourly rate of 51 cents for white labor and 41 cents for Orientals. Provision is also made for a further increase to 54 cents per hour in January next.

Time and a half for overtime is stipulated in the agreement, which is subject to termination with 30 days notice by either parties on any April 30.

The two companies in the agreement undertake to recognize the Powell River and Ocean Falls locals of the International Brotherhood of Pulp Sulphite and Paper Mill Workers, and the International Brotherhood of Papermakers as accredited agencies among employees for the purpose of collective bargaining.

Production Ratio Report

(These statistics are based upon paper production reports to the American Paper and Pulp Association).

COMPARATIVE MONTHLY SUMMARIES

Months	1937	1936	1935	1934
January	90.3% (c)	76.1%	65.8%	.....
February	90.1% (c)	77.9%	70.0%	.....
March	90.3% (c)	76.0%	70.5%	.....
April	92.1% (c)	82.3%	70.0%	.....
May	90.6% (c)	81.6%	69.4%	.....
June	87.3% (c)	80.7%	72.3%	.....
July	81.9% (c)	77.3%	64.9%	.....
August	83.0% (c)	81.5%	70.9%	.....
September	.....	80.5%	71.9%	58.2%
October	.....	87.6%	75.6%	64.7%
November	.....	88.0%	75.3%	61.7%
December	.....	85.9%	71.2%	59.6%
Year Average	.....	81.3%	70.5%	.....
Year to Date				
First 36 weeks	87.5%	79.2%	69.0%	.....

COMPARATIVE WEEKLY SUMMARIES

CURRENT WEEKS, 1937		CORRESPONDING WEEKS, 1936	
*August 7	82.6%	August 8	80.2%
*August 14	82.1%	August 15	80.9%
*August 21	83.8%	August 22	81.4%
*August 28	83.3%	August 29	83.5%
*September 4	80.9%	September 5	81.0%
*September 11	(h)66.7%	September 12	(h)71.2%

The following statistics show the number of mills reporting by ratio groups:

	Number of Mills Reporting, Current Weeks					
Ratio Limits	Aug. 7, 1937	Aug. 14, 1937	Aug. 21, 1937	Aug. 28, 1937	Sept. 4, 1937	Sept. 11, 1937
0% to 50%	67	82	70	65	67	83
51% to 100%	250	235	247	246	231	144
Total Mills Reporting	317	317	317	311	298	227

* Subject to revision until all reports are received.
(c) Basic capacity data have been adjusted to correspond with ratings reported by individual companies.

PAPERBOARD OPERATING RATIOS

According to reports from the National Paperboard Association, per cents of operation, based on "Inch-Hours", were as follows:

Mos.	1937	1936	1935	1934	Mos.	1937	1936	1935	1934
Jan.	80% (e)	61%	61%	....	July	67% (e)	69%	59%	....
Feb.	86% (e)	67%	67%	....	Aug.	....	75%	65%	....
Mar.	87% (e)	68%	67%	....	Sept.	....	76%	69%	62%
Apr.	89% (e)	70%	61%	....	Oct.	....	82%	76%	63%
May	86% (e)	68%	61%	....	Nov.	....	79%	70%	56%
June	75% (e)	68%	65%	....	Dec.	....	74%	60%	52%

Week end. Aug. 7, 1937—73%
Week end. Aug. 14, 1937—75%
Week end. Aug. 21, 1937—73%
Week end. Aug. 28, 1937—74%
Week end. Sept. 4, 1937—73%
Week end. Sept. 11, 1937—59% (h)

(e) Basic figures revised to include new members of the National Paperboard Assn.
(h) Holiday week; percentages based on six days' operation.

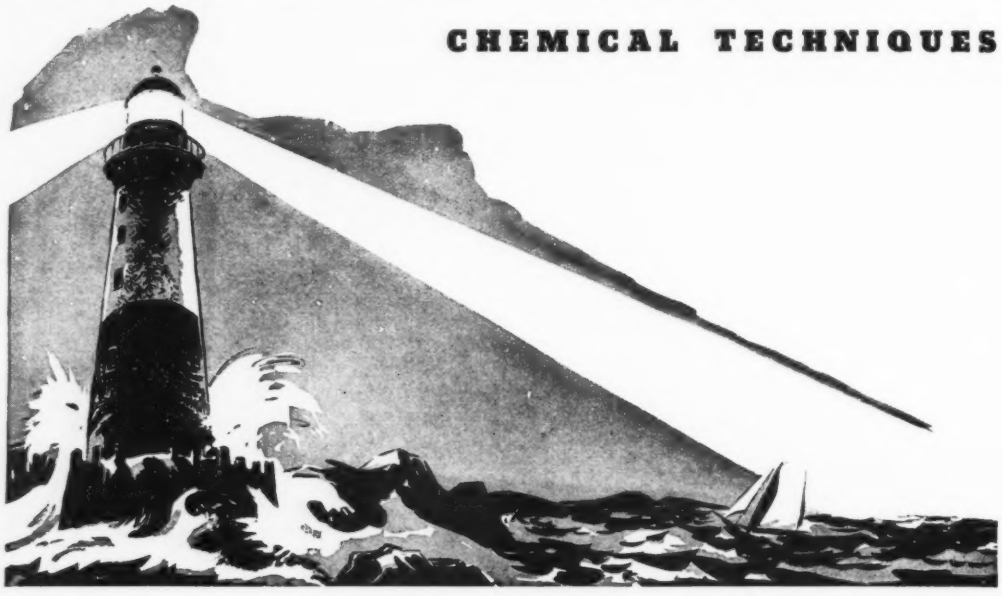
New $1,500,000 Electric Plant

APPLETON, Wis., Sept. 20, 1937.—Construction of a $1,500,000 hydro-electric plant in 1938 by the Wisconsin Public Service Corporation was announced last week by J. P. Pulliam, Milwaukee, Wis., president. Application for its approval is to be filed with the Wisconsin Public Service Commission in the near future.

The proposed plant will be located on the Wisconsin River midway between Merrill and Tomahawk, Wis., below the company's present power plant at Grandfather Falls. It will have a capacity of approximately 17,500 kilowatts. The location is adjacent to the paper manufacturing area of the Wisconsin River Valley, and the plant is being erected to take care of constantly increasing power demands.

The company is adding approximately 5,000 kilowatts to its capacity this year with the construction of a new dam and generating plant on the site of the former Tomahawk Pulp and Paper Company at Tomahawk, Wis.

•STEADIER GOING—IN THE LIGHT OF CHEMICAL TECHNIQUES



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Section of the
Technical Association of the Pulp and Paper Industry

Edited by Ronald G. Macdonald, Secretary

A Study of the Retention of Dyestuffs on Paper Making Fibers Under Various Conditions*

By Ward D. Harrison[1]

Abstract

A spectrophotometric method for determining dye retention has been developed which uses Beer's law as its fundamental principle. By the use of this method dye retentions for twenty dyes were determined on the more common pulps under varying conditions of hydrogen ion concentration, consistency, temperature, time, and freeness. In addition a spectrophotometric method for determining dye retention was developed which uses the Kubelka and Munk equation as its fundamental principle. The results obtained by this method checked with the results obtained by the method using Beer's law, thereby establishing the validity and applicability of this equation. The Freundlich adsorption equation was found to represent the retention data.

Paper dyeing has increased considerably in the past decade, primarily because of the large growth in the specialty business. This growth, coupled with increased technical knowledge, has induced the dye manufacturers to increase continually their facilities for serving the paper maker. Due to the fact that it has long been recognized that this can be accomplished only when a technical viewpoint is taken, the use of dyes has been put on a more scientific basis. In the relentless search for new and better colors, the dye companies have built up a wealth of technical knowledge which cannot be overestimated. Out of this have come many new refinements, of which the determinations of optimum physical and chemical conditions for the dyeing reaction are good examples.

However, even though a great deal of work has been carried out in the paper dyeing field, there is an apparent scarcity of quantitative data concerning the retention of dyes. Work for the most part has been aimed in a direct way at the economics of the problem. This has been done by actually matching whatever was to be dyed, using all possible dye formulas, within the limits of the shade, and then calculating the most economical one by taking into consideration the cost of each individual dye. If, however, the quantitative retentions of the various dyes available were known for the particular conditions of the problem, these data, along with the cost of the dyes, would immediately eliminate certain dyestuffs in working out a color formula from an economic standpoint. In addition, and even more important in so far as this work is concerned, quantitative retention data obtained under well-selected conditions should throw some light upon the trends to be expected in commercial practice. Also, it is hoped that this work will be a stepping stone in the right direction to a more complete understanding of the dyeing mechanism.

The study of the retention of dyestuffs on paper making fibers under various conditions has been undertaken with the following objectives:

1. To develop a method for determining the retention of dye on paper making fibers.
2. To study the effect of variables on the retention of dye, such as type of dye and its concentration; temperature, pH, and consistency of the pulp; time of reaction; type of fiber, its chemical constants, and method of preparation; and the effect of alum and sulphuric acid.
3. To point out the applicability of the retention data to theoretical equations.

Paper is ordinarily dyed by the addition of dye to the beater during the processing of the pulp. The pulp is later formed into a sheet on the paper machine, at which time a considerable amount of water, commonly called white water, carrying with it fiber and dye, is removed from the pulp. The retention of the dye is the amount of dye retained in the sheet, and the problem of determining this may be attacked by two different methods. The first method consists in determining the amount of dye in the sheet after its manufacture, while the second method is to determine the amount of dye left in the white water. In the latter method, the amount of dye in the sheet may be calculated by subtracting the amount found in the white water from the amount added to the beater.

Method of Determining Dye Retention on Paper Making Fibers

At first, no method could be found for directly determining the amount of dye in a sheet. A colorimetric method for determining dye concentration in white waters, using Nessler tubes, was considered, but, due to its subjective and inaccurate nature this was discarded. An accurate objective method which would show small differences in retention was necessary, if reliable results were to be obtained. A spectrophotometric method, using "Beer's Law" as its fundamental principle for determin-

* Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, Waldorf-Astoria Hotel, New York, N. Y., Feb. 22-25, 1937.

A portion of a thesis submitted in partial fulfillment of the requirements of The Institute of Paper Chemistry for the degree of Doctor of Philosophy from Lawrence College, Appleton, Wis., June, 1936.

[1] Riegel Paper Corporation, Milford, N. J.

ing the amount of dye in the white water, was developed and found to be satisfactory.

This involved the determination of the transmittance of the white water solution, i.e., the relative capacity of the solution to transmit rays of light of a specific wave-length. The transmittance of the white water from a given dyeing was determined for the wave-length range from 400 to 700 millimicrons by means of the General Electric recording color analyzer. By the use of Beer's law the dye retention was calculated, after the proper correction for the turbidity of the solution had been made.

Method of Preparing White Waters

In preparing a white water, sufficient distilled water (at 20 deg. C., unless otherwise stated) was added to three grams of pulp (oven-dry basis) so that, when the dye and acid were added, the mixture would be of the correct consistency. The pulp mixture was then placed in a malted milk mixer, the correct amount of dye run in from a burette, a stop watch started, and the acid used for setting the dye added. At the moment the reaction time was up, the dyed pulp was removed from the stirrer, and immediately made into a sheet on the sheet-making apparatus, consisting of an ordinary 6-inch Büchner funnel equipped with an 80-mesh wire and connected to a 2-liter suction flask carrying a vacuum of 14 inches of water. The sheet formed in this way was removed by couching off on a smooth surfaced metal plate (British sheet mould drying plate) (*1*) which just fitted the 6-inch Büchner funnel, pressed between clean blotters at a pressure of 100 pounds per square inch for exactly one minute, air dried under tension (by the use of British sheet mould drying rings), and stored in the dark for spectrophotometric examination. The white water caught in the flask of the sheet-making apparatus was filtered through a Jena filter to remove fibers and preserved for later spectrophotometric examination.

Beer's Law

As stated above a spectrophotometric method, using Beer's Law as its fundamental principle, was found satisfactory for determining the amount of dye in the white water. The use of Beer's law in determining dye retention is dependent upon dye standards, solutions of known concentration for each dye, and a method of accurately comparing dyed white waters with the standard solutions. Beer's law states that the logarithm of the transmittance is directly proportional to the concentration.

In materials such as dye solutions, which are homogeneous, the absorption (the process of disappearance of light upon passing through a medium) of light by them depends upon the thickness, in accordance with Bouguer's law. Bouguer set forth this law in 1729. It was further developed by Lambert and consequently is frequently called Lambert's law of absorption. Suppose that a layer of unit thickness transmits a fraction t of the light incident upon it. This layer will absorb a fraction $(1-t)$. Consequently a thickness x of the material will transmit the fraction t^x, and the intensity of the light transmitted is

$$I = I_o t^x,$$

where I_o is the intensity of the incident light.
This expression may be written

$$I = I_o e^{-ax}$$

where a, the absorption coefficient, equals -log t, and e is the base of Naperian logarithms. The absorption coefficient of a solution is in general proportional to the concentration of the solute. The absorption coefficient can therefore be written as

$$a = bc$$

where c is the concentration, and b is the absorption coefficient for unit concentration. With this substitution, the equation becomes

$$I = I_o e^{-bcx}$$

which is known as Beer's law. (*2*)

In the practical application of this law a cell of constant thickness was used to measure the transmittance, I/I_o, of a dye solution. Beer's law can therefore be written as

$$I/I_o = e^{-kc}$$

where k equals bx. This expression may further be written as

$$\log (I/I_o) = \log e^{-kc} = -kc$$

where I/I_o is the transmittance by definition. In other words, the logarithm of the transmittance is a linear function of the concentration.

Dye standards for the dyes investigated were prepared and the logarithms of their transmittances were plotted against their concentrations for each dye. The resulting straight lines show that this law is applicable under the conditions of this investigation.

Color Analyzer

A General Electric recording color analyzer (*3*) was used for all transmittance and reflectance measurements. When the instrument is to be used for obtaining the spectral transmittance of liquids, the result obtained is relative to the transmittance of the glass cell when filled with distilled water. On the other hand, in measurements of reflectance of hand sheets, the standard used is freshly prepared magnesium carbonate.

Correction for the Turbidity of White Waters

The white water obtained from a natural sheet, that is, one to which no dye has been added, has a slightly cloudy appearance in comparison with distilled water, even though it has been filtered. This fact shows up conclusively when the transmittance data of the two solutions are examined. For instance, the transmittance of unbleached sulphite white waters at one wave-length was found to be 14.4 per cent less than that for distilled water. Thus, correction has to be made for this turbidity of the white water. In determining the nature of this correction, dye in known amounts was added to a natural white water and its transmittance determined. It was found that the product of the transmittance of a dyed white water and a constant gave a corrected transmittance reading which, when compared with the curves obtained with the standard dye solutions, produced a result within one per cent of the amount of dye added. The constant in these calculations was obtained for any given pulp by dividing the transmittance of distilled water by the transmittance of the natural white water at the same wave-length used in determining the transmittance of the dyed white water.

The turbidity of white waters for any given pulp was very nearly constant due to the fact that the white waters were put through a Jena filter of 1G1 porosity immediately after their separation from the pulp. Any deviation from the natural white water would throw the determination off, because of an increase or a decrease in the scattering of light.

It has been noticed, from transmittance data on dye standards, that every dye solution investigated has a transmittance equal to the transmittance of distilled water at some point in the visible wave-length band. From this it may be postulated that a white water containing a dye should have the same transmittance as its natural white water at the wave-length where the corresponding standard dye solution transmittance coincided with the distilled

white water transmittance. This fact was of considerable value as a quick method for determining any deviation in turbidity from the natural white water standard.

Due to the fact that the turbidity of the white water decreases with time, it was found necessary vigorously agitate the white water solution and to make the transmittance determination at a definite time after this agitation.

For the most part, dyeings were made at 0.6 per cent consistency by adding three grams of pulp to 500 cubic centimeters of water. At other consistencies, the weight of pulp was varied, but the volume of water was always kept constant and in this way the volume of white water obtained remained the same in each case.

The transmittance of the dyed white water was determined from its transmission curve at the wave-length where maximum deviation occurs for the dye solution relative to distilled water (for any given dye, this wavelength remains a constant) and corrected for turbidity in the manner which has already been discussed. The dye concentration corresponding to the corrected transmittance was then obtained from the plotted data for the standard dye solution. With the volume of white water known, it was possible to calculate the amount of dye present in the white water and hence the per cent retention of dye.

The errors inherent in this retention method have been proved to be small. It was found that dyed white water solutions could be produced under identical conditions which would not vary more than 0.1 per cent in transmittance. It was also found that the color analyzer would reproduce results within 0.1 per cent. With this in mind, the error in calculated retention was determined when the transmittance of several white waters produced under various conditions was purposely changed by 0.1 per cent. The results should give a general idea of the errors to be expected under any condition.

It was found in carrying out this calculation that as the transmittance of a given dye solution for a given weight dyeing was varied over fairly small limits, the per cent retention varied as a linear function of the transmittance. In the light of this fact a change in the transmittance could be arbitrarily made to correspond to a large error, the per cent retention determined, and then the change due to 0.1 per cent change in transmittance calculated. Accuracy was conserved in this manner. It was found that the heavier dyeings had the smallest errors due to 0.1 per cent error in transmittance, varying between 0.1 and 0.3 per cent of the weight of the dye for 3-pound dyeings. An error of 0.1 per cent in the transmittance for ½-pound dyeings, however, produced errors up to 1.5 per cent in the retention.

TABLE I.—RETENTION OF DYE ON VARIOUS PULPS

Pulp	Pounds Dye per 1000 Pounds Pulp	Du Pont Victoria Green SC Per Cent	Du Pont Brilliant Crocein FL Per Cent	Pontamine Fast Red 8BL Per Cent
Unbleached Sulphite	½	97.9	57.7	58.0
	1	96.5	50.0	54.0
	1½	96.0	45.7	52.2
	3	95.3	41.8	49.1
Bleached Sulphite	½	87.9	62.0	64.0
	1	86.4	53.8	61.0
	1½	85.8	49.0	59.1
	3	85.0	43.3	56.2
Unbleached Kraft	½	98.3	54.5	50.0
	1	97.2	46.3	47.6
	1½	96.6	42.6	46.6
	3	95.5	39.4	45.0
Bleached Kraft	½	88.5	49.9	60.0
	1	87.1	42.6	57.4
	1½	86.5	39.5	56.2
	3	85.7	36.5	54.1
Bleached Soda	½	80.7	60.0	55.0
	1	79.0	54.0	52.0
	1½	78.9	49.5	50.1
	3	78.0	42.0	45.5
Rag	½	74.7	66.0	63.8
	1	73.3	59.5	60.0
	1½	72.6	55.0	58.0
	3	71.0	47.2	55.3
Groundwood	½	95.2	25.0	33.0
	1	94.0	23.8	30.0
	1½	93.6	23.0	28.6
	3	92.8	22.9	25.6

Retentions Obtained Under Various Conditions

The results of this investigation may be divided into eight sections, each section of which takes into consideration one of the important variables in the dyeing reaction, while all the rest of the variables are held constant. In this way it has been possible to study the retention of the various dyes on different stocks under various conditions. The standard conditions used in this work were 0.6 per cent consistency, pH of 4.9 obtained by the use of sulphuric acid, a temperature of 20 deg. C., and a reaction time of ten minutes. Unless otherwise stated, these conditions were held constant in each determination. The dyes, Du Pont Victoria green SC, Du Pont brilliant crocein FL, and Pontamine fast red 8BL, which are basic, acid, and direct, respectively, were used as typical examples throughout the investigation. Sulphuric acid was used in most of the work because alum produced a flock in the white water which was undesirable. Results in part H of this section justify this use of sulphuric acid.

RETENTION ON UNBLEACHED AND BLEACHED SULPHITE AND KRAFT, BLEACHED SODA, GROUNDWOOD, AND RAG PULPS

The pulps most generally used in paper making operations, bleached and unbleached sulphite and kraft bleached soda, groundwood, and rag, were chosen for the pulp variable in this investigation. The various pulps were dyed with the three typical dyestuffs in four different strengths (½-, 1-, 1½-, and 3-pound dyeings). The retention results are tabulated in Table I. From these results it is evident that the various types of pulps have widely varying affinities for Du Pont Victoria green SC. but, generally speaking, the amount of lignin present has a considerable influence in holding this dye to the fiber. It should be noticed that groundwood, which is a mechanical pulp and not comparable with chemical pulps, is well up in the list in its affinity for basic dyes.

Du Pont brilliant crocein FL is attracted by these pulps only slightly, the best results being obtained with those containing the least lignin.

The results obtained with Pontamine fast red 8BL indicate that the retention of dye, even though better than that of Du Pont brilliant crocein FL, is much less than that obtained with Du Pont Victoria green SC. In addi-

TABLE II.—RETENTION OF DYES ON UNBLEACHED AND BLEACHED SULPHITE PULP AT VARIOUS pH'S

Hydrogen Ion Concentration and Pulp	Pounds Dye per 1000 Pounds Pulp	Du Pont Victoria Green SC Per Cent	Du Pont Brilliant Crocein FL Per Cent	Pontamine Fast Red 8BL Per Cent
Unbleached Sulphite 3.9	½	96.0	57.7	58.2
	1	94.5	50.1	54.1
	1½	94.1	45.6	52.2
	3	93.8	41.9	49.1
Unbleached Sulphite 4.9	½	97.9	57.7	58.0
	1	96.5	50.0	54.0
	1½	96.0	45.7	52.2
	3	95.3	41.8	49.1
Unbleached Sulphite 5.9	½	97.7	50.1	56.1
	1	96.2	42.2	52.4
	1½	95.9	38.1	50.4
	3	94.9	34.1	47.3
Bleached Sulphite 3.9	½	85.8	62.0	64.4
	1	84.8	53.5	61.5
	1½	84.2	48.9	59.4
	3	83.2	43.1	56.8
Bleached Sulphite 4.9	½	87.9	62.0	64.0
	1	86.4	53.8	61.0
	1½	85.8	49.0	59.1
	3	85.0	43.3	56.2
Bleached Sulphite 5.9	½	87.8	54.0	62.1
	1	86.3	44.7	58.9
	1½	85.6	40.5	57.3
	3	85.1	36.1	54.3

tion, highly purified pulps show dye retentions which are considerably better than those of the more lignified pulps.

Retention on Unbleached and Bleached Sulphite and Kraft at Various pH's.

Sulphite and kraft pulps are the most important types of furnishes that are dyed from a tonnage standpoint, so they alone were considered for the study of the effect of pH on dye retention. These pulps, both bleached and unbleached, were dyed at three pH's, 3.9, 4.9, and 5.9, with the three typical dyes in four different strengths (½-, 1-, 1½-, and 3-pound dyeings). The results are tabulated in Table II for the sulphite and in Table III for the kraft pulp.

In summarizing the effect of pH on the retention of the three dyes, when dyeing sulphite and kraft pulp, it can be said that the acid dyes are by far the most affected by pH changes. Retention decreases rapidly above a pH of 5.0. Direct dyes are the least affected by pH changes while basic dyes, in general, have an optimum pH near 5.0. In addition to these facts it has been observed, that with Pontamine fast red 8BL the characteristics of its pH curves, when per cent retention is plotted against strength of dyeing, are always the same. For different pulps the retentions are different, but the shapes of the curves are similar. The retentions for the direct dye at pH's of 4.9 and 5.9 are always about the same, while the retention at a pH of 5.9 is always a little lower. Even though these generalizations have been made for Pontamine fast red 8BL, the retention of the dye is only slightly affected by pH in comparison with other dyes. The characteristics of the pH curves for Du Pont brilliant crocein FL are also similar regardless of the pulp being dyed. In every case the retentions for pH's of 3.9 and 4.9 are practically the same with the retention at a pH of 5.9 being lower. The characteristics of the pH curves for Du Pont Victoria green SC are likewise similar, with the retentions at a pH of 4.9 and 5.9 in general being the same and that at a pH of 4.9 being slightly higher. A dyeing made at a pH of 3.9 shows a lower retention. Only three dyes, one typical of each of the three main classes of dyestuffs, have been investigated and it is possible that different dyes in the same class would act differently. However, in so far as this investigation is concerned, it can definitely be pointed out that for any given dye, the characteristics of its pH curves, when per cent retention is plotted against strength of dye, are always very nearly the same for the pulps studied.

TABLE III.—RETENTION OF DYES ON UNBLEACHED AND BLEACHED KRAFT PULP AT VARIOUS pH'S

Hydrogen Ion Concentration and Pulp	Pounds Dye per 1000 Pounds Pulp	Du Pont Victoria Green SC Per Cent	Du Pont Brilliant Crocein FL Per Cent	Pontamine Fast Red 8BL Per Cent
Unbleached Kraft 3.9	½	97.5	54.8	50.1
	1	96.5	46.6	47.6
	1½	96.0	42.9	46.8
	3	94.9	40.0	45.0
Unbleached Kraft 4.9	½	98.3	54.5	50.0
	1	97.2	46.3	47.6
	1½	96.6	42.6	46.6
	3	95.5	39.4	45.0
Unbleached Kraft 5.9	½	96.2	50.0	48.3
	1	97.1	42.6	45.9
	1½	96.4	38.1	44.3
	3	95.4	35.1	43.1
Bleached Kraft 3.9	½	88.2	50.2	60.1
	1	87.1	43.0	57.8
	1½	86.4	40.0	56.8
	3	85.4	36.9	54.7
Bleached Kraft 4.9	½	88.5	49.9	60.0
	1	87.1	42.6	57.4
	1½	86.5	39.5	56.2
	3	85.7	36.5	54.1
Bleached Kraft 5.9	½	88.5	44.6	57.8
	1	87.0	37.8	55.0
	1½	86.5	34.4	53.9
	3	85.5	32.1	51.9

TABLE IV.—RETENTION OF DYES ON UNBLEACHED AND BLEACHED SULPHITE PULP AT VARIOUS CONSISTENCIES

Per Cent Consistency	Pounds Dye per 1000 Pounds Pulp	Du Pont Victoria Green SC Per Cent	Du Pont Brilliant Crocein FL Per Cent	Pontamine Fast Red 8BL Per Cent
Unbleached Sulphite 0.3	½	96.3	53.3	46.4
	1	95.4	46.0	42.8
	1½	94.9	43.0	41.8
	3	94.0	39.6	37.8
Unbleached Sulphite 0.6	½	97.9	57.7	58.0
	1	96.5	50.0	54.0
	1½	96.0	45.7	52.2
	3	95.3	41.8	49.1
Unbleached Sulphite 1.0	½	98.6	76.3	78.7
	1	97.8	68.1	73.1
	1½	97.3	64.0	70.0
	3	96.3	58.0	64.7
Bleached Sulphite 0.3	½	86.1	58.8	52.4
	1	85.1	50.8	47.2
	1½	84.6	46.8	45.7
	3	83.9	42.0	41.7
Bleached Sulphite 0.6	½	87.9	62.0	64.0
	1	86.4	53.8	61.0
	1½	85.8	49.0	59.1
	3	85.0	43.2	56.2
Bleached Sulphite 1.0	½	88.4	81.3	91.0
	1	87.6	73.1	84.9
	1½	87.0	68.2	81.1
	3	86.1	61.3	75.8

Retention on Unbleached and Bleached Sulphite at Various Consistencies

In the light of the facts brought out in section B above, it was decided that the use of unbleached and bleached sulphite alone would be sufficient to bring out the trends in dye retention due to any of the variables in the dyeing reaction. In order to study the effect of consistency on retention, unbleached and bleached sulphite were dyed at three consistencies, 0.3, 0.6, and 1.0 per cent, with the three typical dyes in four different strengths (½-, 1-, 1½-, and 3-pound dyeings). The retentions are tabulated in Table IV, and, as was expected, the stock dyed at one per cent consistency showed the highest retention because it had the greatest amount of dye present per unit volume of stock. The 0.6 per cent stock showed the next best retention for a given pulp and strength of dye, while that of the 0.3 per cent stock gave the poorest retention. In each case the ½-pound dyeings gave higher retentions than those dyeings which contained greater amounts of dye.

Retention on Unbleached and Bleached Sulphite at Various Temperatures

Unbleached and bleached sulphite were dyed at three temperatures, 20, 40, and 60 deg. C., with three typical dyes in four different strengths (½-, 1-, 1½, and 3-pound dyeings). The retentions obtained are tabulated in Table V. These results show that the retention of basic dyes is not affected from a practical standpoint by tempera-

TABLE V.—RETENTION OF DYES ON UNBLEACHED AND BLEACHED SULPHITE PULP AT VARIOUS TEMPERATURES

Temperature and Pulp	Pounds Dye per 1000 Pounds Pulp	Du Pont Victoria Green SC Per Cent	Du Pont Brilliant Crocein FL Per Cent	Pontamine Fast Red 8BL Per Cent
Unbleached Sulphite ..... 20°	½	97.9	57.7	58.0
	1	96.5	50.0	54.0
	1½	96.0	45.7	52.2
	3	95.3	41.8	49.1
Unbleached Sulphite ..... 40°	½	97.2	58.6	59.8
	1	96.4	50.5	55.5
	1½	95.9	46.0	53.4
	3	95.0	42.1	49.8
Unbleached Sulphite ..... 60°	½	98.0	60.0	61.8
	1	97.0	51.9	57.1
	1½	96.0	47.5	54.3
	3	95.3	43.9	50.7
Bleached Sulphite ..... 20°	½	87.9	62.0	64.0
	1	86.4	53.8	61.0
	1½	85.8	49.0	59.1
	3	85.0	43.3	56.2
Bleached Sulphite ..... 40°	½	87.7	62.3	65.8
	1	86.5	54.1	61.8
	1½	85.7	49.5	60.1
	3	85.0	44.0	57.0
Bleached Sulphite ..... 60°	½	87.5	63.8	68.4
	1	86.5	55.2	64.4
	1½	85.9	51.1	62.3
	3	85.4	45.0	59.5

ture; acid dyestuffs are retained very little better at increased temperatures of the dyeing reaction, while direct dyes are retained somewhat better at higher temperatures.

Retention on Unbleached and Bleached Sulphite at Various Reaction Times

In studying the effect of time on the retention of dyes, unbleached and bleached sulphite pulp were dyed for different periods, 10, 30, and 60 minutes, with the three typical dyes in four different concentrations (½-, 1-, 1½-, and 3-pound dyeings). The results of the retentions under the various conditions are tabulated in Table VI and show that Du Pont Victoria green SC is not affected to any great extent by time of reaction. Du Pont brilliant crocein FL is somewhat affected, giving higher retentions for longer times, while Pontamine fast red 8BL produces sizeable increases in retention when the reaction time is lengthened.

Retention on Unbleached Sulphite at Various Freenesses

To study the retention trends as the freeness of the pulp was varied, unbleached sulphite was dyed at six different freenesses with the three typical dyes in just one strength, 3-pound dyeings. The results of the retentions under these conditions are tabulated in Table VII. These results show that, in every case, the retention of a dye may be increased by lowering the freeness of the pulp. Direct dyes, such as Pontamine fast red 8BL, are affected the most by freeness changes, acid dyes such as Du Pont brilliant crocein FL are next, while the retention of basic dyes, such as Du Pont Victoria green SC, is very little affected by a change in freeness of the pulp.

Retention of Various Dyes on Unbleached Sulphite

In studying the retention of various dyes, 3-pound dyeings on unbleached sulphite were made with twenty different dyes obtained from the three main classes of dyestuffs. The results of the retentions are tabulated in Table VIII. In choosing these dyes, one and sometimes two were picked from each different structural grouping in each class.

These dyes were picked so as to have a dye from each important grouping and at the same time have them overlap enough so as to determine whether or not dyestuffs having the same groupings would have approximately the same retentions.

The results show that dyes having the same groupings do not necessarily have the same retentions. All the basic dyes used in this investigation have retentions above 85 per cent, except for the notable exception of basic brown. The direct dyestuffs, as a class, are retained better than the acid dyes but not as well as the basic dyes. In addition, it should be pointed out that Purpurine, a direct dye, has an exceptionally high retention and Anthraquinone blue, an acid dye, has an exceptionally low retention.

TABLE VI.—RETENTION OF DYES ON UNBLEACHED AND SULPHITE PULP AT VARIOUS REACTION TIMES

Time in Minutes and Pulp	Pounds Dye per 1000 Pounds Pulp	Du Pont Victoria Green SC Per Cent	Du Pont Brilliant Crocein FL Per Cent	Pontamine Fast Red 8BL Per Cent
Unbleached Sulphite 10	½	97.9	57.7	58.0
	1	96.5	50.0	54.0
	1½	96.0	45.7	52.2
	3	95.3	41.8	49.1
Unbleached Sulphite 30	½	97.9	59.7	68.7
	1	96.4	51.5	63.3
	1½	96.0	47.0	60.0
	3	95.4	42.3	53.9
Unbleached Sulphite 60	½	98.0	64.1	77.7
	1	96.5	53.5	70.1
	1½	96.1	48.3	65.5
	3	95.4	43.0	57.0
Bleached Sulphite 10	½	87.9	62.0	64.0
	1	86.4	53.8	61.0
	1½	85.8	49.0	59.1
	3	85.0	43.3	56.2
Bleached Sulphite 30	½	87.0	65.0	75.8
	1	86.2	54.5	68.5
	1½	85.8	49.8	64.7
	3	85.0	43.7	59.0
Bleached Sulphite 60	½	87.9	67.3	86.1
	1	86.4	55.2	77.4
	1½	86.0	50.7	71.3
	3	95.3	44.0	61.0

TABLE VII.—RETENTION OF DYES ON UNBLEACHED SULPHITE AT VARIOUS FREENESSES

Time in Minutes	Freeness	Du Pont Victoria Green SC	Du Pont Brilliant Crocein FL	Pontamine Fast Red 8BL
0	860	95.3	41.8	49.1
10	810	95.8	47.5	53.4
20	705	96.7	54.0	62.5
30	560	97.4	59.5	72.0
40	460	97.9	63.5	79.3
50	250	98.3	68.0	84.5

TABLE VIII.—RETENTION OF VARIOUS DYES ON UNBLEACHED SULPHITE

Basis Dyes	Per Cent Retention
Du Pont Victoria Green SC with triphenylmethane grouping.....	95.3
Du Pont Rhodamine B with xanthene grouping.....	85.4
Du Pont Auramine Conc. with ketonamine grouping.....	94.8
Du Pont Methylene Blue ZX with thiazine grouping.....	96.3
Du Pont Basic Brown BR with disazo grouping from diamines.....	53.8
Du Pont Safranine T Extra with azine grouping.....	94.8
Du Pont Methyl Violet NE with triphenylmethane grouping.....	91.8
Acid Dyes	
Du Pont Brilliant Crocein FL with monoazo grouping.....	41.8
Du Pont Anthraquinone Blue B with anthraquinone acid grouping...	5.6
Du Pont Nigrosine WSB Powder with very complex unknown structure	15.9
Du Pont Quinoline Yellow Conc. with quinoline grouping.....	11.7
Du Pont Orange II Conc. with monoazo grouping.....	14.2
Pontacyl Violet 4SB with triphenylmethane grouping.....	36.1
Direct Dyes	
Pontamine Fast Red 8BL with disazo grouping.....	49.1
Du Pont Purpurine 4B Conc. with disazo grouping from diamines..	76.1
Pontamine Black E with trisazo grouping.....	55.7
Du Pont Brilliant Paper Yellow Conc. with mono-stilbene grouping..	39.6
Pontamine Fast Scarlet 4BS with disazo grouping.....	30.6
Pontamine Yellow SXP with di-stilbene grouping.....	25.9
Pontamine Fast Yellow NNL with triazole grouping.....	58.3

Retention on Unbleached Sulphite When Alum or Sulphuric Acid Was Used with and without Size

In studying the retention of dyes when alum or sulphuric acid was used with and without size, 3-pound dyeings were made with the dyes, Du Pont Victoria green SC, Du Pont brilliant crocein FL, Du Pont Orange II, and Pontamine fast red 8BL, on unbleached sulphite. In addition, the increase in retention obtained when size and alum are both used was investigated. The results of the dye retentions obtained in this study are tabulated in Table IX.

These results show quite conclusively that the retentions are the same, from a practical standpoint, when either alum or sulphuric acid is used. The use of size in connection with alum increases the retentions of the dyes except in the case of Du Pont Victoria green SC, which is not affected. In the case of acid dyes, Du Pont orange II shows a marked increase in its retention, while Du Pont brilliant crocein FL shows only a moderate increase. Pontamine fast red 8BL is also increased slightly by the addition of size to the furnish. Size and alum were investigated in order to determine their effects on retention results. Sulphuric acid was used for the most part of this investigation because it produced results which were similar to those obtained with alum as has been shown above, and in addition, did not produce a floc in the white waters. Alum produced a floc in the white waters, which necessitated an exceptionally large correction in the trans-

TABLE IX.—RETENTION OF DYES ON UNBLEACHED SULPHITE WITH ALUM OR SULPHURIC ACID

	Du Pont Victoria Green SC	Du Pont Brilliant Crocein FL	Du Pont Orange II	Pontamine Fast Red 8BL
Sulphuric Acid	95.3	41.8	14.2	49.1
Alum	95.2	41.9	14.7	48.2
Size and Alum	95.3	43.1	19.8	50.3

mittance when examined spectrophotometrically, and, therefore, was objectionable.

The Applicability of Retention Data to Theoretical Equations

The retention data obtained in the preceding section has been found applicable to the Kubelka and Munk equation and the Freundlich adsorption equation. These equations will be taken up separately as follows:

KUBELKA AND MUNK EQUATION

In proving the applicability of the Kubelka and Munk equation, it appeared that the best approach was to use the equation for determining dye retention. Such a method was developed and the results checked very well with those obtained by the retention method using Beer's law. Since it was not thought necessary to check all the results obtained by the retention method to prove the applicability of the Kubelka and Munk equation, only ½-, 1-, 1½-, and 3-pound dyeings of the three typical dyes on unbleached and bleached sulphite were considered in this part of the investigation. Hand sheets obtained when white waters were produced for these conditions were saved for this determination. The following section will consider in detail the equations, procedure, results, and errors of the method.

Derivation of the Equation

Steele *(4)* has used the Kubelka and Munk equation to good advantage in studying the optical characteristics of paper. Due to the fact that the amount of dye in a sheet of paper affects the optical properties of the sheet, this equation has been studied in connection with this investigation. When light enters a diffusing medium, such as a sheet of paper, part of it is reflected, part of it is absorbed, and part of it is transmitted. In dealing with the color of paper, the light reflected is of primary importance. This is a function of the scattering and absorption characteristics of the paper together with the thickness of the sheet and the reflecting characteristics of the background. Steele gives the derivation of the Kubelka and Munk equation concerning the reflection of light from diffusing media and obtained:

$$R_\infty = 1 + \frac{K}{S} - \sqrt{\frac{K^2}{S^2} - 2\frac{K}{S}}$$

which is the general equation for reflectance at infinite thickness. In this equation, R_∞ is the reflectivity of a pad sufficiently thick to be opaque, K is the absorption coefficient and S is the scattering coefficient for the paper. Rearranging and solving for K/S,

$$\frac{K}{S} = \frac{(R_\infty - 1)^2}{2R_\infty}$$

is obtained. This equation has been used as the basis of the method in applying the Kubelka and Munk equation for the determination of the retention of dyes.

Method of Determining Dye Retention

The reflectance of a sheet of paper is dependent upon the optical properties of the materials present in it. Of all the materials that go into a sheet of paper, the dye is one of the most important in this connection. The more dye in a sheet, the less the reflectance and vice-versa. As shown in the foregoing section, Kubelka and Munk have derived a formula which shows the scattering and absorption coefficients of a sheet to be a function of its reflectance. With the help of this equation, another method of determining the dye retention has been developed. The K/S value of a sheet can be calculated from its reflectivity, as derived above, and is dependent upon the materials of which the sheet is made. It is assumed that the K/S value for the dye in a sheet may be determined by subtracting the K/S value of a natural sheet (one containing no dye) from the K/S value of a dyed sheet providing conditions, other than dye, have been kept constant.

It may be further assumed that the weight of dye in a sheet may be expressed as the product of K/S times a constant. This constant may be determined, once and for all, for a given dye and a given furnish, by using the data obtained by the retention method with Beer's law. The weight of dye in a similar sheet may be calculated by multiplying the K/S value of the sheet by this constant.

Retentions were calculated by the use of this equation for Du Pont Victoria green SC, Du Pont brilliant crocein FL, and Pontamine Fast Red 8BL respectively on unbleached and bleached sulphite pulp with ½-, 1-, 1½-, and 3-pound dyeings. The constant for each dye and furnish was determined from the results obtained from a ½-pound dyeing.

Table X shows a summary of data determined by the retention method using the Kubelka and Munk equations, together with the corresponding data determined by the retention method using Beer's law.

Limits of Error in the Retention Method Using the Kubelka and Munk Equations

In examining the errors inherent in the method for determining dye retentions by using the Kubelka and Munk equations, it was found that dyed paper could be produced experimentally under identical conditions which would not vary more than 0.1 per cent in reflectivity if the proper precautions were taken. It was also found that, for any given point on a sheet, the color analyzer would reproduce itself to within 0.2 percent. With the above results in mind, the error in retention was calculated when the reflectance was assumed to change by 0.1 per cent for ½-, 1-, 1½-, and 3-pound dyeings of Du Pont Victoria green, Du Pont brilliant crocein FL, and Pontamine fast red 8BL on unbleached and bleached sulphite pulp. These three dyes were chosen as representatives of the three common classes of dyestuffs and give a general idea of the errors to be expected with any dye. It was found that, in carrying out these calculations, the calculated amount of a given dye in a given sheet when plotted against the reflectance gave a smooth curve. In the light of this fact, it is apparent that the per cent error at different reflectances will be difficult. The errors due to a 0.1 per cent change in reflectance are, for the most part, less than 0.6 per cent in retention with the notable exception of Du Pont Victoria green SC which varies up to 1.7 per cent in retention.

TABLE X.—SUMMARY OF PER CENT RETENTION DATA DETERMINED BY THE METHOD USING BEER'S LAW AND THE CORRESPONDING DATA OBTAINED BY USING THE KUBELKA AND MUNK EQUATIONS

Pounds Dye per 1000 Pounds Pulp	½	1	1½	3
Victoria Green SC				
Unbleached Sulphite				
Method using Beer's Law	97.9	96.5	96.0	95.3
Method using K. & M. Eq.	97.9	96.7	94.7	92.2
Bleached Sulphite				
Method using Beer's Law	87.9	86.4	85.8	85.0
Method using K. & M. Eq.	87.9	86.6	83.1	82.6
Brilliant Crocein FL				
Unbleached Sulphite				
Method using Beer's Law	57.7	50.0	45.7	41.8
Method using K. & M. Eq.	57.7	49.3	45.5	40.4
Bleached Sulphite				
Method using Beer's Law	62.0	53.8	49.0	43.3
Method using K. & M. Eq.	62.0	54.2	48.2	42.4
Fast Red 8BL				
Unbleached Sulphite				
Method using Beer's Law	58.0	54.0	52.2	49.1
Method using K. & M. Eq.	58.0	54.8	51.2	48.8
Bleached Sulphite				
Method using Beer's Law	64.0	61.0	59.1	56.2
Method using K. & M. Eq.	64.0	60.2	57.8	54.2

FREUNDLICH ADSORPTION EQUATION

The exact mechanism of the adsorption of dye on fiber is still a matter of dispute. Some of the available evidence shows that adsorption is due to chemical combination of the dye with the free valences of atoms on the surface of the fibers, while, in other cases, the evidence indicates that adsorption is due to the retention of the dye by capillary action in the exceedingly fine pores of the fiber. No doubt, in some cases, the two phenomena coexist.

Whatever the mechanism of adsorption, it is assumed that the equilibrium between the dye and the adsorbing fiber may be expressed by the Freundlich equation *(5)*,

$$a = xc^{1/n}$$

where a is the amount of dye adsorbed per unit mass of adsorbing material, and c is the amount of dye in the white water which is in equilibrium with the reacting materials; x and n are constants. The value of n determines the firmness of the dye retention and x is proportional to the active surface on the fiber. While it has been claimed that this equation has theoretical basis, it is probably safer to regard it as empirical in character. From the form of the equation, it is obvious that if one plots the logarithm of the weight of dye in a sheet against the logarithm of the weight of dye in the white water, the equation demands that the data follow a straight line, the slope of which is equal to the exponent, $1/n$. This offers a ready means of testing the applicability of the Freundlich equation to any given set of data.

The adsorption isotherms of seven pulps dyed with three typical dyes in four different strengths (½-, 1-, 1½-, and 3-pound dyeings) were calculated and plotted; straight lines were obtained with the exception of a few very slight deviations.

These results are typical of those which would be obtained under any of the conditions in this investigation and show that the Freundlich adsorption equation represents the retention data.

Conclusions

It has been proved that the method using Beer's law for determining dye retention is reliable, and that a number of conclusions may be drawn in regard to the retention data obtained by the use of this spectro-photometric method.

At very low dye concentration, relatively large percentages of dye are held on the fiber. As the dye concentration is increased, the amount held on the fiber at the end of a given time also increases, but at a much less rapid rate than would correspond to a linear relationship.

Basic dyestuffs are attracted strongly by lignified fibers and give dye retentions above eighty-five per cent. When bleached, however, the fibers attract these dyestuffs to a lesser extent; it can be said that, in general, the fiber is the most important variable in so far as basic dyes are concerned. The temperature, time, and hydrogen ion concentration of the reaction mixture have very little effect on the retention of this class of dyestuff, while increased consistency and lower freeness cause considerable increases in retention.

With acid dyestuffs, the fiber variable is not so important for dye retention. Relatively small changes are obtained when the fiber is changed, the purer pulps giving higher retentions. The temperature of the reaction apparently has very little effect on the retention of acid dyes. Hydrogen ion concentration affects the retention probably more than any other variable, giving higher results at a pH of less than five. With high consistency and low freeness, increases in retention are noticed, while increases in time of reaction have only small effects.

The retention of direct dyestuffs is somewhat affected by the type of pulp being dyed. Bleached and refined pulps produce slightly higher retentions than the highly lignified pulps. The hydrogen ion concentration and the temperature of the reaction mixture have very little effect on the retention, while increased time of reaction, increased consistency, and decreased freeness produce considerable increases in the retention of this class of dyestuff.

In addition, a method for determining dye retention was developed which used the Kubelka and Munk equation as its fundamental principle. The results obtained by this method were in good agreement with those obtained by the method using Beer's law, and from this, it can be concluded that the Kubelka and Munk equation, which gives scattering and absorption coefficients as a function of reflectivity, is sound from the standpoint of applicability.

In the course of this investigation the dye retention results were applied to the Freundlich adsorption equation. It was found that, when the logarithm of the weight of dye adsorbed is plotted against the logarithm of the weight of dye left in the white water, straight adsorption isotherms were obtained. No definite generalization concerning the behavior of adsorption can be formulated, but, with such good agreement of these results with the equation in question, it is believed that the method as studied and described will be of value in future work dealing with a study of the mechanism of paper dyeing.

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Chili Increases Paper Production

WASHINGTON, D. C., September 22, 1937—Production of paper and paper products has made notable progress in Chile during recent years. Prior to 1931 over 70 per cent of the paper requirements were imported; today the industry produces newsprint, writing, and wrapping papers, paperboards, strawboards, and products thereof. While the quality of the domestic product is not equal to the imported article, it is being improved rapidly and the eventual elimination of all foreign papers except in specialized products is to be expected. The output of writing, printing, and wrapping paper amounted to 19,232 metric tons in 1935. Imports during the same year amounted to 13,993 tons, an increase of 82 per cent over 1933, but a decrease of 52 per cent compared with 1929.

Canada Exports More Pulp

WASHINGTON, D. C., September 22, 1937—According to figures just released by the Dominion Bureau of Statistics exports of wood pulp from Canada during the 4 months' period April to July inclusive, totaled 290,596 short tons as against 240,021 short tons during the corresponding period in 1937, an increase of 21 per cent. Exports for the current year were as follows: kraft pulp, 43,585 tons; bleached sulphite, 129,064 tons; unbleached sulphite, 60,822 tons; mechanical pulp, 44,718 tons; other pulp, 12,407 tons.

Relatively the largest increase occurred in exports of unbleached sulphite which were 20 per cent higher this year than in 1936. Exports of bleached sulphite showed an increase of 13 per cent and kraft pulp 15 per cent; exports of mechanical pulp were about 10 per cent higher than a year ago.

Some Aspects of Starches in the Paper Industry*

By Dr. Irving J. Saxl[1]

Abstract

In view of the complexity of starch products, it has been found that the evaluation of the various types of starches and converted starches by methods of fluidity and pH determinations alone does not give representative figures.

In selecting starch products for the paper industry, they have to be evaluated according to the uses to which they are put. From this requirement two different types of tests became of importance. One series of tests concerns itself with the evaluation of starches as fillers and binders, while the other tries to bring about quantitative relations of the behavior of starch products as they refer to surface coating materials.

The theoretical fundamentals for the above are discussed, practical methods described and pictures of instruments shown, with the aid of which a numerical approach to these problems has been made.

Starches have not been used as extensively in the paper industry as is perhaps possible if they are thoroughly understood. While starches have found some practical application, their general use is as yet somewhat limited although they can produce a substantial reduction of the material expense in paper manufacture.

In evaluating starches, we must realize that they are practically never used alone, but almost always in a combination, for instance, with glue, and particularly with casein. They may be mixed with softening agents such as emulsified oils and other materials.

In considering mixtures of glue, starch, casein, pulp and similar materials, it is perhaps helpful to consider them from an angle that has been found useful in another category of engineering. It is suggested herewith to call such materials *non-metallic alloys.*

This automatically brings about the fact that small changes in any one component of this mixture can substantially influence the total structure of the material. Comparable to vanadium, a very small amount of which can materially change the structure from an iron to a high grade steel, it often is possible to arrive at similar results with materials of non-metallic character.

A true plasticizer working with such materials would then actually be a solvent for the components in consideration. It would be of such low vapor pressure that for all practical intents and purposes it does not evaporate out of the mass in which it acts as a plasticizer, and thus remains connected in between the individual particles.

In actual work, it has been found that such important characteristics as tensile strength can be raised substantially if the proper non-metallic alloy is built up.

It is extremely interesting to make microscopic cross-sections of sheets of paper and similar materials and to observe them under a metallographic microscope. Comparable to metals, we can then see a fine structure of the paper, and from the interlocking of the different grains important data can be obtained for the improvement of paper and similar materials. Equally, the influence of certain treatments such as calendering as it affects the surface characteristics of paper can be shown definitely in their influence upon the microstructure of paper.

Going beyond paper, it might perhaps be appropriate to state in this connection that the question of non-metallic alloys is of he highest importance for the entire industry of synthetic plasics, from bakelite to cellulose acetate, and from molding materials to synthetic yarns, to mention a few of the instances where considerations of this type greatly facilitate the work with such materials.

The harder sized a paper is, the larger is the amount of binder required. Casein is perhaps the most generally used material for binding the pigments. It will be readily understood that at the present price of about 19½ cents a pound for casein and 29 cents for glue, the introduction of a substantial amount of starches and soluble starches at, say, about 4 cents a pound, can very markedly reduce the expense of paper-making. This, however, has to be done carefully and it is only by intelligent development, using the most up-to-date resources of chemistry and physics, that we can employ a good amount of starch and yet will not necessarily get the soft handle and feel that starches generally give paper, but rather a stiff sheet that has snap, a characteristic which is produced by the glue.

Starch for Filler and Coating

In considering the use of starches in the paper industry we may view them from two different angles.

One of the uses of starch in the paper industry concerns itself with its application in combination with a filler. The other application of starch lies in its use as a surface coating agent.

Accordingly, considerations of starch properties as far as their application to the above mentioned two purposes are concerned, fall in two categories. One is the investigation of the binding, the cohesive and mechanical properties of starches, starch sheets and combinations of starch with casein, glue and various fillers. The other lies in the determination of such starch characteristics as will influence the surface structure of paper. To this category pertain color, gloss, smoothness, heat conductivity and similar factors.

What specifications should we put up in order to get the most out from the starch product in the proficient and controlled manufacture of paper products? Going back to the primary characteristics of starches and the uses to which the inherent qualities of starches are to be put, we will have to consider this question from two different angles, one that concerns itself with the value of starch as a binder and filler while the other tends to express quality in terms of characteristics that become apparent in the form of coatings.

Viscosity Measurements

The application of starch in the form of a filler for various types of paper is based largely upon the fact that properly prepared starches build a structure with the resin size and alum or wax size and alum, as the connecting link between the cellulose particles, the pigments, the sulphate of aluminum, clay and other products going into the paper base.

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* Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, Waldorf-Astoria Hotel, New York, N. Y., Feb. 22-25, 1937.

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If we are to consider this quality of interlocking and glueing the heterogeneous mixture with which we have to deal, it will be realized that only tests should be used that are applicable to the many different grades of paper products which are known to be more diversified than almost any other product.

The tests used today, mostly on starches concern themselves primarily with their fluidity and their pH. As is well-known, in order to make such tests, a given quantity of starch is heated in a definite volume of water for a given period of time, or under standard conditions, and then subjected to viscosity or fluidity measurements, be it in the form of time of flow from a graduated pipette or funnel, or by tests made with other forms of viscosimeters.

The question arises whether viscosity can be considered a representative characteristic of cohesion and binding power. In giving this problem some fundamental consideration, we have to refer first to the molecular structure of starch. Chemically speaking, starch is one of the polyoses, and closely related to sugar and cellulose. Its chemical formula is $(C_6H_{10}O_5)n$.

The word chemical is emphasized hereby because we obviously have to deal not only with the total weight of carbon, hydrogen and oxygen in the formula, but in addition with physical constants that are diverse for various reasons.

Starches, as is well-known, consist of small microscopic granules. These are imbedded in the cells of plants. Depending upon the species, we find sizes in the starch granules ranging from the 3 to 7 microns for rice, to the giants of potato starch that may range as big as 0.05 to 0.09 mm. In between we have intermediary sizes such as wheat starch that has 20 to 30 microns and corn starch with 15 to 20 microns.

Not only is the physical structure different, but also the opening of the starches occurs at different temperatures and total mechanical agitation. We all have been shown in our early studies how starch granules will swell up in water, and when heated, finally will explode. It must be realized, therefore, that starch consists of a minimum of two different substances. The skin, which is substantially amyl-cellulose, and a soluble part of the inside of the starch granule, called granulose.

The amylo-cellulose may constitute as much as 40 percent of the total substances. In as much as these skins strongly influence the viscosity without being necessarily a contributing factor toward the adhesive properties or coating properties of starches, the evaluation of said characteristics by methods of viscosity measurements alone does not seem adequate. It is well-known, moreover, that the characteristics of the granules are different from those of starch paste, colloids and size. Some indication of the variance of the individual starches is given by the factor n at the end of the formula $(C_6H_{10}O_5)n$.

If this variance would be a quantitative one only, we might find in this factor a characteristic indicator for the specific properties of starch. Actually, however, we are dealing with products that have a much higher variability than just one factor of linear multiplication.

Starch is a natural product. Its shape is characteristic for the species. It is not uniform but a mixture of various forms and degrees of ripeness and, moreover, the product that we are to use industrially has gone through industrial processes of preparation that influence its properties.

We are today at the beginning of a development in the starch industry which gets away from starch as such and begins to improve the properties of starches by converting them. The large starch molecules are split into smaller ones and water is added simultaneously. Such hydrolization can be produced by various agents, among which may be mentioned diluted acids, salts and diastatic enzymes.

It is interesting to note the difference in color in the well-known iodine reaction as produced in accordance with the gradual progress of the decomposition. While starches give the well-known blue reaction, it should be noted that the first stages of decomposition, the so-called erythrodextrines, are colored red and violet by iodine. Moreover, they are highly soluble in mixtures of alcohol and water.

If the hydrolysis continues, the iodine reaction may disappear completely while the solubility in diluted alcohol increases. The maltose $(C_{12}H_{22}O_{11})$. H_2O may be considered as the final product within this group. It must be understood, however, that acids in turn may split up maltose into two molecules dextrose (D Glucose) $(C_6H_{12}O_6)$.

It must be realized, therefore, that the degree of hydrolization has much to do with the molecular weight and structure of the starch products in question. Moreover, hydrolization does not attack all granules with their different range in size and construction the same and that therefore we have to deal with mixtures of different stages of conversion. In view of the above, only such methods will give us practical results that integrate the different components within the mixture, rather than analytical methods of constitutional analysis.

pH and many other factors influence the adhesive properties of starches. Moreover, their combination with resin size is substantially dependent upon the manner in which the different products are brought together. To mention only one of many variables, it must be realized that different heating produces different adhesive properties, particularly in considering converted and semi-converted starches. These are made, for instance, by cooking with diluted acids, with a progressive deformation of the original material, and a final end product of maltose and isomaltose.

We are dealing with intermediary stages, *the varying viscosity and solubility of which must not necessarily reflect the varying binding power.* Using a crude comparison, it is entirely possible to make a mixture of filler in water that contains practically no binder, and thus will not produce a reasonably strong paper. Yet, the apparent time of flow of such suspended material from a graduated pipette may be rather high.

Equally, a heavy oil may have a high viscosity and yet have no binding power whatsoever.

On the aforegoing two comparisons, it will be obvious that *viscosity must not necessarily be representative of binding strength.* It is entirely possible to have so-called thin-boiling starches with many times the binding power of heavy, thick-boiling starches. Moreover, even within one uniform starch product, the viscosity changes during cooking, and so does the binding power.

From a gradual increase in viscosity with the increasing swelling of the granules which may be observed microscopically, we arrive at a point where the skins of the granules rupture. From there on, the viscosity of the paste goes down again. No microscopic resolution is obtained, and the solution settles out upon staying or centrifuging. Equally, the film strength and the binding power of such pastes goes down. If such overboiled starch is used in the manufacture of paper, the product will turn out to be too soft and of insufficient strength.

In heating starch paste under pressure up to three atmospheres, a solution is produced that rotates the plane of polarized light to the right. Measurements of polarization in starch solutions, however, have as yet not been correlated directly to the binding power or to the light reflecting power of starch materials. Therefore, measure-

ments that connect the properties of starch in a more direct manner with the desired characteristics are being preferred.

In view of this status of the matter, viscosity alone, if not corroborated by other tests, must be considered inadequate and insufficient for an objective specification of the binding power.

Tests for Binding Power

How, then, can we arrive at a satisfactory expression for the cohesive and adhesive properties of starches?

In as much as we have to deal with many additional factors in discussing adhesion and cohesion such as the type of pulp, resin, size, the alum, gelatin, casein and other materials that may be included in the filler, it is advisable to include such other materials in any starch tests that we may want to make, because *it is not only the material as such but the combination* with the other ingredients that give the desired effect.

In order to measure adhesion (and, in a modification, tackiness) the following simple test can be made. A strip of paper may be taken (for instance from a handsheet) 1 cm. wide, and which consists of a mixture of ingredients reasonably closely resembling the type of paper to be made. The upper part of this strip may be covered with the size to be tested and another strip of this paper pressed against it. The extruding size is wiped clean and the two paper strips are pressed together for a given period of time with a standard weight of 50 grams. Thereafter, the strips are inserted in a tensile-strength machine and pulled apart. The reading of the tensiometer gives then a factor which is sufficiently proportionate to the binding strength of the size in question, in combination with the materials to be held together.

Comparative tests between different sizes can be made in this manner objectively and those starches selected that will show the greatest binding power for the material in question.

While it must be realized that such measurements are to be considered strictly relative, and that they will vary with the base material, it is found sometimes desirable to test the starch film as such for cohesion within itself. Two methods for such tests have been found practical. In order to do this, one part of starch and twelve parts of water may be cooked up, to the point where the granules burst. A measured quantity of this may be poured upon a polished glass plate or other polished surface. The size upon the plate may be dried in an oven at 80 deg. C., whereupon it is exposed to standard temperature and moisture conditions, and stripped from the surface, For certain types of starches it is necessary to add a standard percentage of softener.

After equilibrium between the starch and the standard climate has been obtained, the film may be stripped from the carrier surface. It is cut in strips of 1 cm. width and examined for its dynamic characteristic. In order to determine the yield point, the recovery and the final rupture, the sample may be attached to a testing machine such as shown in Fig. 1. The strip of size is held hereby between a movable lower clamp and upper clamp, the height of which can be adjusted by a precision micrometer screw. By lifting or lowering the chains held between the lower clamp and the upright at the right side of the picture, more or less strain may be applied to the strip of film and in this manner the load versus extension characteristic of the strip can be found precisely (Fig. 2).

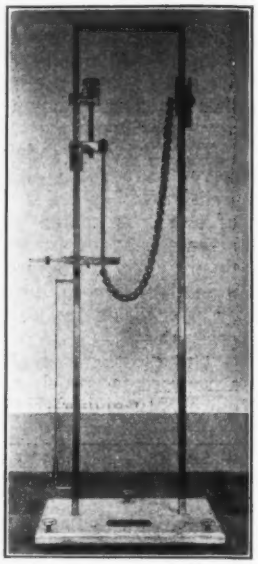

Fig. 1.
Precision Testing Apparatus for the Determination of the Dynamic Characteristics. (Load-versus-Elongation Characteristic).

The third method of measuring cohesion is based upon the fact that it has been found that the relative conditions in the dry product are practically comparable to the relative conditions in the gel form. Accordingly, for making tests of this type, a concentrated mixture of pulp is made, including the various fillers, the starch paste, and the other ingredients, everything being identical to the final mixture with the one exception that the percentage of water is reduced so far that a gelatinous mass is obtained upon cooling. This mass is placed upon a gelometer of the type shown in Fig. 3 and load versus compression diagrams are taken. As can be seen from the picture, a sample of the gelatinous mass is held at room temperature in a surrounding water bath. The plunger impresses upon the surface of the sample. This impression is the deeper, the more weight applied to the right lever arm. In order to determine precisely the depth of penetration in the sample, the latter is brought to zero position of the pointer by a precision calibrated micrometer screw. In this manner load versus penetration characteristics of the size may be obtained and, most important, reliable figures for

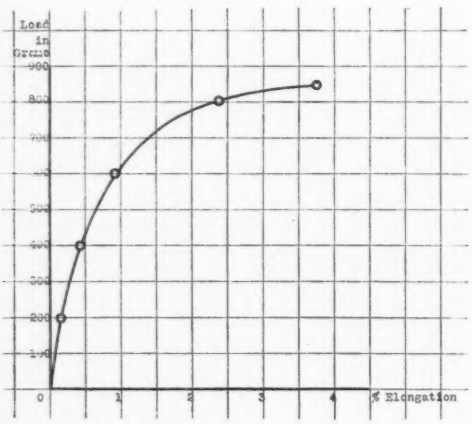

Fig. 2.
Dynamic Characteristic of starch film.

Fig. 3.
Gelometer.

elastic recovery and mechanical hysteresis (Fig. 4). It is here where we have a definite advantage over viscosity measurements as a *filler without binder shows permanent plastic deformation* almost immediately, while the proper type of combination of adhesive with filler, pigment and other materials contained in the paper shows excellent *recovery* characteristics upon reduction of the load.

While we tried in the aforegoing to separate the facts of surface coating from the binding properties within the base paper, it should be understood that for all practical intents and purposes no such clean dividing lines do exist. In the actual paper, surface and inside are intimately interlocked. Making a cross-section, one sees clearly that the coating agent penetrates into the lower layers of the paper core, and it will be equally seen from such microscopic cross-sections that the surface of the paper not only is responsible for gloss and color but that it builds a more or less continuous film which in itself lends strength to the paper. While we, therefore, for purely didactic reasons have made a dividing line between coating and cohesive material, it should be clearly understood that this is merely for purposes of facilitating the scientific approach to the problem, and that *for all practical purposes we have to deal with one more or less uniform material.*

The evaluation of film strength, therefore, should be made not only for the film as such but rather by incorporating various amounts of starches in a test sheet. It was found by R. M. Cobb that the strength of the resulting paper goes through a maximum and that amounts below or above this starch content are disadvantageous in use. The experiments of the writer corroborate these findings.

There are however certain soluble starches today on the market that require various amounts to be used for maximum strength and the total relative amounts of starch employed can be changed very substantially by using different amounts of conversion in the starch and different origins of the original starch grain. For instance, corn

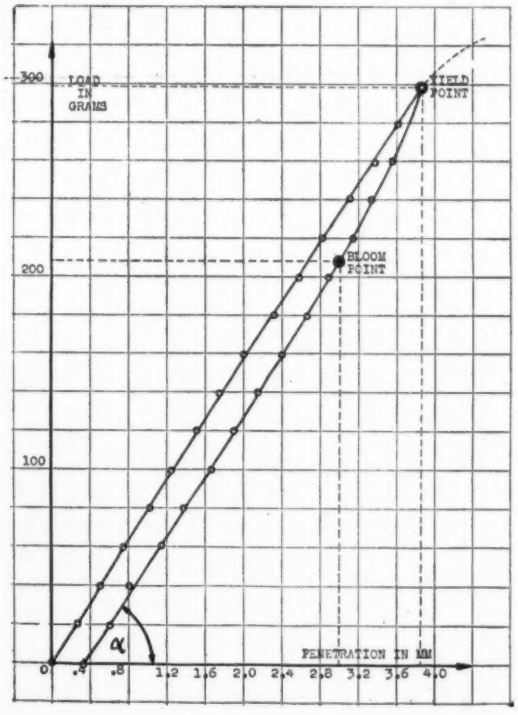

FIG. 4.
Jellying Characteristics: 1. Jell Strength, 2. Bloom Number, 3. Yield Point, 4. Jell Factor, 5. Elastic Hysteresis, 6. Elastic Recovery.

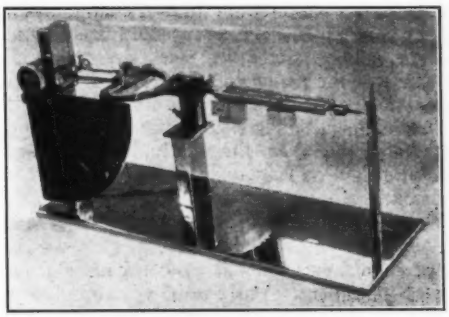

FIG. 5.
Stiffness Tester for the Determination of: 1. Stiffness, 2. Yield Point and 3. Elastic Hysteresis.

starch in its various degrees of solubility compared to tapioca starch, and again rice starch products, give different effects.

Furthermore, the penetration of the binder is of the greatest importance in influencing the body stock. Obviously the deeper it sinks in and the stronger its film strength is, the more its roots will hold the body stock together, which then will be strengthened by the surface film of connected starch micelles.

Starch is a strong film as such, and if this film is interlocking with the body stock its physical properties can be influenced substantially.

It is not only the starch but also the type of raw material that is used that will influence the properties of starch and paper. It is well-known that the strength increases from groundwood and soda pulp, to soda pulp and sulphite. The degree of moisture and the various amounts of causticizing influence the strength and appearance of the final sheet. Starches alone do not quite give the complete picture. They must be considered as they refer in their relation to the other materials that are contained in the paper. In other words, the present status is that starch should be used as an assistant only to body stock, but that it is not the binder proper, without other additions.

Equally, starch enters in counter-relation with the other products in coating. Not only are the effects of casein and glue to be considered but equally alum, resin size and many other materials are intimately interrelated with the properties of starch. Whether we produce hard size, medium or soft size paper, we have to consider more than the binding properties and light-reflecting properties of the starches alone.

Characteristics of Coatings

While the above determinations concern themselves primarily in bringing about quantitative factors for evaluating the cohesive and adhesive properties of starches, we have to consider now also those characteristics that concern themselves with the surface characteristics as produced in the coating of papers. Here we have to deal with factors of light reflection as well as with certain characteristics that influence the sense of touch such as roughness, smoothness and similar properties. In order to bring about a quantitative understanding of these surface factors, optical instruments have been in use for quite some time. Spectrometers of various construction have been used in order to determine the color characteristics of surface coatings, and equally, various gloss meters have found practical application in order to give quantitative data for various surfaces as produced by different methods of manufacture and different size prod-

ucts. It must be understood that the amount of size as well as the type of size influences the gloss in the coating. Generally speaking, the more size present the lower the gloss. The specific properties of starch that lend gloss to the surface coating will have to be investigated further.

It is not sufficient to consider the chemical side of the problem only, but also the methods of manufacturing enter substantially. For instance, if book or lithograph paper is made, a run of 7 to 9 nips on the calender will produce entirely different results than a different number of nips, as is well-known. Equally, it is known that brushing before calendering such as used for art gloss influences the type of glossiness. The use of various gloss meters in connection with the evaluation of the effect of various starches is therefore necessary.

To these optical methods which may be assumed to be generally known, some other tests have been added recently.

One factor that influences to a large extent the handling of paper is the hardness and stiffness of the surface film. A number of stiffness testers are known, one of which is shown in Fig. 5 because, to the best of our knowledge, it is the only one sensitive enough to evaluate the stiffness of individual thin starch films, to give simultaneously *quantitative factors for the resiliency and mechanical hysteresis and the yield point* of starch films, as well as of paper plus starch combinations.

In this instrument a strip of paper is inserted into a clamp which is in turn attached to an analytical scale. By turning a pivot to which the paper is attached, pressure is exerted upon the left side of the scale, which has to be counteracted by a weight on the other side of the balance, in order to bring the pointer on the scale back to zero position. Moreover, by moving the pivot backward, the weight applied can be released and in this manner the mechanical hysteresis of the material may be found. In taking load versus deflection data, a loop is circumscribed. It is obvious, the larger the area of this loop is, the softer is the material and vice versa, an almost straight line characteristic showing a springiness approaching the characteristic of ferrous material (Fig. 6).

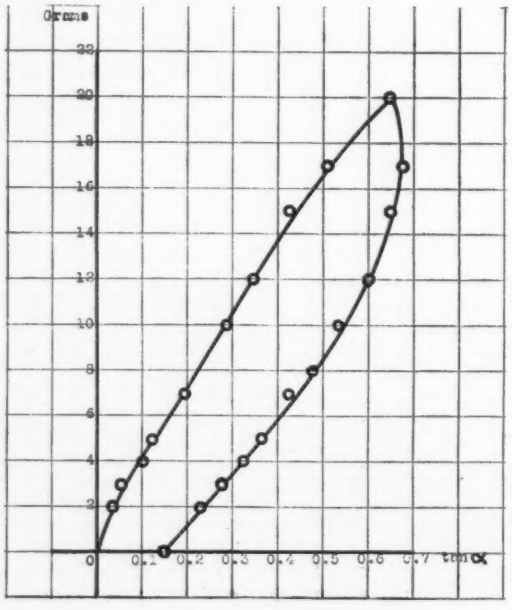

FIG. 6.
Record of stiffness test. The tangens of the curve with the abscissa is proportionate to the elastic hysteresis.

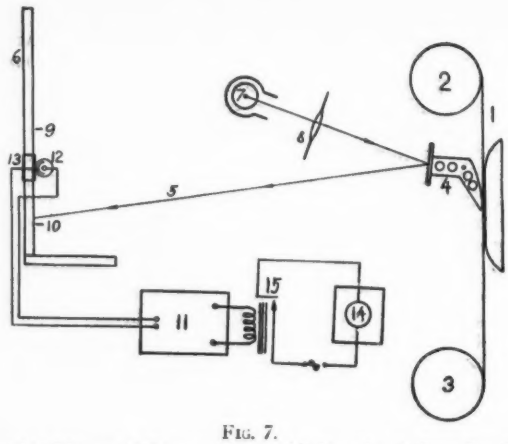

FIG. 7.
Schematical Diagram of Evenness Tester with Photoelectric Recording Equipment.

Among the testing instruments that are known throughout the industry, of course, the folding and tearing strength testers have to be mentioned. Several constructions are known. Fundamentally speaking, they show the arrangement of the cracking and the split in the paper, and it is generally assumed that the shorter the distance of the split the better is the finish.

Other tests used for papers are substantially abrasion tests which sometimes are combined with methods of aging paper. Machines of this type are somewhat comparable to the wear machines used in connection with artificial perspiration with various chemicals in the textile industry. Also, the evenness of papers may be influenced by the starch content. It may be evaluated quantitatively with the evenness tester (Figs. 7, 8 and 9).

Another important factor in the production of paper is its smoothness. The type of size mixture as well as the

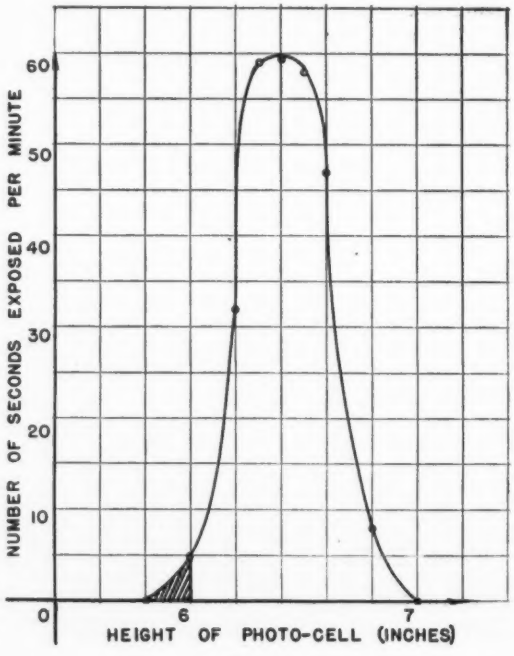

FIG. 8.
Photoelectric Record of Even Material.

methods of application such as the proper application of the quantitative amount of pressure, heat and speed influence these surface characteristics. In order to determine them quantitatively, the following two instruments have been developed.

The first is a friction tester (Fig. 10). A standard strip of paper is laid around a chromium-plated and highly polished wheel, which tends to rotate counter-clockwise because it is loaded with a pointer protruding to the left. The paper is laid around the wheel and held by two binding posts which in turn are attached to the two lower levers.

It will be understood that more braking power has to be applied to the rotating wheel if we are dealing with a smooth surface and that the coefficient of friction will be higher for a rough paper and then less braking action is needed. Accordingly, we have to vary the weights on the lower levers by moving them nearer or further from the center of rotation and we can determine from these two lower weights the coefficient of friction for the standard strip of paper. The exact calculation for the above has been given previously.* In this connection reference is made to the fact that the final result can be represented by the simple relation:

$$\mu = \frac{\log T_1 - \log T_0}{\pi}$$

Hereby is μ the coefficient of friction, T_1 is weight on the left side, T_0 is weight on the right side of the lever.

With the aforementioned method it is possible to determine the total integrated action over the entire test surface in terms of the coefficient of friction. If a finer resolution of this result is desired, in other words, if we want to get more quantitative data which will tell us whether we are dealing with a strip of considerable graininess or whether individual points of coarseness have been removed, a different method has been found practical. As will be seen in Fig. 1, a standard sample of starch, upon a microscope slide, is moved by a synchronous motor past a phonograph pick-up. It will be understood that the needle of the pick-up will be moved more, and accordingly more current will be produced in the pick-up, if we have to deal with a rough surface than if we are investigating a smooth structure.

This current of the pick-up is fed into an electronic amplifier, the output of which is measured on an output meter. In this manner, if we are dealing with a smooth paste film the needle of the output meter will hardly be moved, while a rough profile will give considerable deflection which can be read correctly and quantitatively on the output meter.

Summary

The author has tried to develop an approach that will show the relative value of starch products in terms that are directly applicable to the individual purposes to which starch is applied.

It is not sufficient to know the viscosity of starch as there are many other factors to be taken into consideration in evaluating such materials, one component of which is sometimes starch. By a better knowledge of the alloying properties of the various starches, in combination with binders, softeners and fillers, substantial reduction of the cost figure in paper manufacture may be made, and, in addition, new types of paper products of superior physical and chemical characteristics may be created.

As a working hypothesis, the term "non-metallic alloys" has been suggested here.

If we want to know something about the efficiency of starch as it pertains to its binding power, when it is applied to a film, we have to test its binding power directly. For such tests the use of standard strips of starch films proper, starch-on-paper tests and gelometer tests have been considered.

As far as the second application of starches is concerned, namely their use as coating, reference has been made to optical instruments as well as to mechanical and electronic apparatus with which it is possible to test the smoothness, the resiliency and the graininess of the individual surfaces.

The physical approach introduces quantitative, reliable, exact data in clear figures in the evaluation of starches and other products. Based upon this recognition of facts,

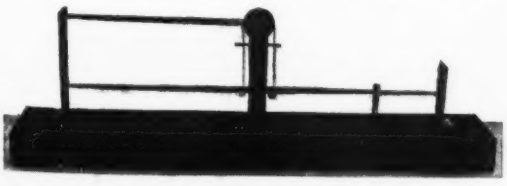

FIG. 10.
Friction Tester.

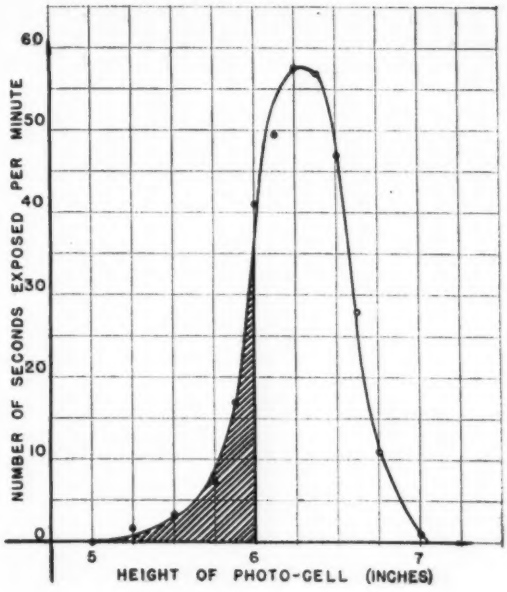

FIG. 9.
Record of Uneven Material. Note large area of Material falling below minimum specifications.

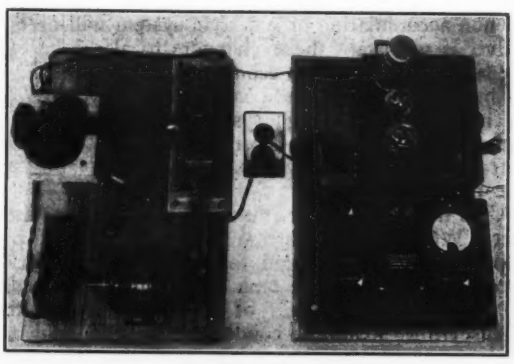

FIG. 11.
Profilographic Recording of the Surface of Paper by the Use of a Phonographic Pick-Up and Vacuum Tube Amplification.

a clear engineering approach is now possible for the production of improved auxiliaries as well as for the standardization of the best methods of their application under conditions of production.

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The Rosenblad System for Recovery of Heat and Sulphur Dioxide in the Chemical Wood Pulp Industry*

By T. Blomen[1]

Heat plays a great part in most chemical industries. Especially in the wood pulp industry, great quantities of heat are required to complete the chemical reactions going on there. These processes, however, do not absorb the heat. Thus all the heat brought into the system or at least most of it will remain in the form of waste heat when the chemical processes are finished. But until now people have made very little use of these big sources of heat. And why? I think because these sources are of such an intermittent nature. Compared with average loads, the peak loads are extraordinarly high. Especially at the blowing of digesters. A plant of old style heat-exchangers constructed for taking the peak load would be too big and too expensive in comparison with the value of heat that can be saved.

These circumstances brought Mr. Rosenblad to discuss the problem as follows:

The sources of heat may at first be classified according to their varying flow and intensity. We form the ratio

$$x = \frac{\text{average load}}{\text{peak load}}$$

and then

$$y = \frac{\text{utilization time}}{\text{total working time}}$$

The product xy of these two factors, we call the utilization factor. With all intermittent flows of heat the utilization factor will, of course, be less than one. The product xy being sufficiently great, it may be economical to use a non-accumulating system for heat recovery. At a certain lower value, however, of the utilization factor, the common non-accumulating or old style system will be too expensive, if you want the exchangers to also take care of the peakloads. To get an economical use of waste heat at still lower values of the utilization factor xy, Mr. Rosenblad invented the storage system for recovery of heat which I am now going to describe. (Fig. 1). This figure illustrates a storage blow-steam condenser plant for sulphate mills.

"A" is the accumulator containing a sufficient supply of water. When the blow steam comes through the pipe *b*, the pump *c* will be started to circulate the water from the cold bottom *d*, of the tank *a*, through the jet condenser *e*, to the cyclone top, *f* of the container. In the jet condenser the steam is condensed by the cold water, thus raising the temperature of the water to about 203 deg. F. The steam condensate enters together with the cooling water at the top of the tank. Gases not condensating escape through the pipe *g*. Due to the difference of the specific gravity and due to the screens, *h*, there will be a distinct demarkation between the cold and the hot water in the tank. The hot water in the top of the tank is drawn off continuously through the pipe *i*, and filter *j*, by the pump *k*, to the hot water apparatus *l*, where it is cooled to about 104 deg. F. The cooled water is returned to the suction side of the cold water pump *c*, or when this pump is idle, it goes to the bottom of the tank. The heat exchanger and the pump in conjunction to it must of course be so proportioned that the border line of the cold and the hot water in the storage tank never may come to the bottom of the tank. The surplus of water corresponding to the steam condensate passes through an overflow pipe *m*, to the drain. The temperature of 203 deg. F. at the bottom of the jet condenser is kept constant by a thermo-controlled valve *n* regulating the amount of cooling water. Water to be heated is brought from the outside to the heat exchanger through the pipe *o* and is led in another pipe *p* to the place where it is to be used—maybe at first to a hot water tank. The quantity of heating water to the hot water apparatus is regulated by a hand-operated valve so that a sufficient flow of water corresponding to the average load of the plant is maintained. (This valve needs only to be adjusted once.)

Apart from blow steam, exhaust vapors from the di-

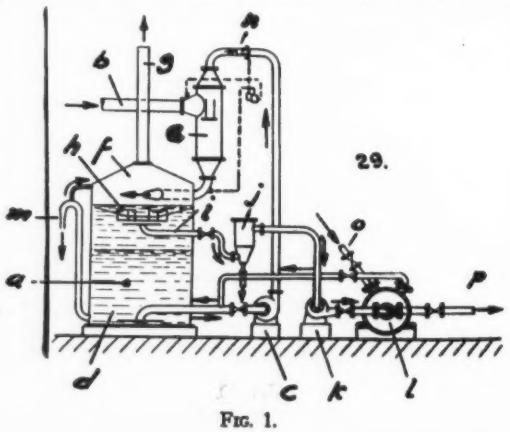

FIG. 1.

* Presented at the Annual Meeting of the Technical Association of Pulp and Paper Industry, Waldorf-Astoria Hotel, New York, N. Y., Feb. 22-25, 1937.
[1] Engineer, Rosenblad-Patenter, Stockholm, Sweden.

gesters and waste vapors from other departments of the mill can, of course, also be led to the blow steam condenser plant and thus be utilized. Someone will perhaps ask why not use the water heated in the jet condenser directly? Why the surface exchanger *l* there? Well, the vapors coming from the digesters generally are mixed with black liquor and evil smelling gases and thus not at all suitable for direct heating of water. By this construction the comparatively expensive surface exchanger running all the time can be much smaller in size than if it had to take the peak load directly, the peak loads often being very high. As an instance we have here in the United States a heat recovery plant where the peak load by blowing out a digester amounts to about 1,750 pounds of steam min. The arrangement has also another advantage. The surfaces of the water-heater will be kept clean. The impurities following the steam are caught by the cooling water in the jet condenser and separated in the filter.

Fig. 2 represents the heat and sulphur dioxide recovery system at a sulphite pulp mill. As you see it is rather similar to the plant just shown. Here you have the storage tank *a*, the jet condenser *e*, the pumps *c* and *k*, and the surface heat exchanger *l*. Quite the same arrangement. But we have an additional part here. That is the gas cooler *g*, on the top of the acculmulator *a*. The sulphur dioxide gas coming from the jet condenser and being about 200 deg. F. is cooled in said cooler to a suitable temperature, perhaps 120 deg. F., before it is led to the absorption ejector—*r* is a digester, *s* a blow pit, *t* a liquor cooler. The nature of the waste heat and thus the problem of heat recovery is here about the same as in the sulphate mills. Depending on the chemical properties of the sulphur dioxide gases, however, they have not until now made use of waste heat from the sulphite mills in the same extent as in the sulphate mills. Usually people have considered it sufficient to cool the gas until 140 deg. F., and to let the cooling water run to waste. Often they cared for no recovery at all neither for heat nor for sulphur dioxide. Nowadays, however, after the introduction of acid-proof steels, we have advantageously built plants for recovery of both heat and sulphur dioxide gases in this manner.

Now I am going to give you some figures from our practice:

1. From a sulphate mill.

Number of digesters—4 units.
Size of digesters—5,000 cubic feet.
Blowing from 340° F.—
Blowing Time—30 minutes.
Steam to the condenser plans—pounds per blow 30,400.
Cooking time 13-14 hr.
Peak load of the jet condenser about 1420 lb./min. = 85,200 lb/hr.
XY = 1/6
Storage tank about 10,000 cubic feet.
38,000 gallons of water per hour is heated from 108-158° F.

II. From a European sulphite mill. In Scandinavian mills, they generally draw off lye before the final blowing out as follows:

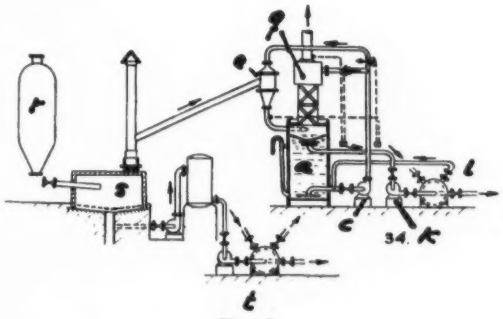

FIG. 2.

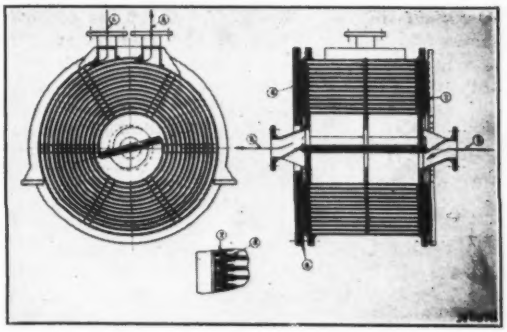

FIG. 3.

Number of digesters—5
Cooking time 13-14 hr.
Size of digesters—5,800 cubic feet each.
Direct heating
Charges per 24 hours—8.7

Temperature of digesters at the finish of cooking—285 deg. F. Relief gassing and drawing off liquor simultaneously for about one hour. This procedure finished, the temperature in the digester is about 245 deg. F. Amount of liquor drawn off—20,000 gallons. With this plant 8,000 U. S. gallons per hour are heated from 50 to about 160 deg. F.

As for the sulphur dioxide, about 4,850 lb. leaves with the relief gas from the top of the digester and about 3,000 lbs. leaves with the steam from the liquor drawn off.

As is shown, the jet condenser plays a great part in the storage system. As a matter of fact it is used both by the sulphate and by the sulphite mills. In the jet condenser a sufficient number of nozzles throws cooling water into the steam to be condensed. Thus the heat transmission is a direct one, cooling water and condensate get intimately mixed and leave the condenser together. The jet condenser is a most effective apparatus, not expensive and requires little space.

The most essential part, however, of the heat storage system and maybe a necessary condition for this system is the very efficient surface heater. Just to make the storage system practically possible, this spiral apparatus was constructed and I daresay well constructed. As it has found a very great use not only in the accumulating system, nor only at chemical pulp mills, but in most industries where heat in general is used for manufacture. Therefore it may be suitable for me to give a little description of this spiral heat exchanger.

But at first some general points of view. The amount of heat transmitted from one medium to another will be determined by the formula:

$$W = k\ F\ (\Delta t)\ \text{B.t.u./hr.}$$

where k = coefficient
F = Heating surface
Δt = Temperature difference

$$\text{thus } \frac{W}{F} = k\ (\Delta t)\ \text{B.t.u./hr. sq. ft.}$$

This product $k\ (\Delta t)$ we use to call the "quality figure" designated by "q". Upon the quality figure in connection with the above-mentioned utilization factor will depend how far a recovery of waste heat is economical. But as soon as the utilization factor and the temperature difference (Δt) is given, we have only to deal with the coefficient k. As you know

$$k = \frac{1}{\frac{1}{\alpha_1} + \frac{1}{\alpha_2} + \frac{\delta}{\lambda}}$$

α_1 = heat transmission coefficient of the heat absorbing medium.
α_2 = heat transmitting coefficient of the heat emitting medium.
δ = thickness of the wall between the media.
λ = heat conductivity of the wall.

The higher the "a" the higher will be the coefficient k. "a," however, is a function of the flow velocity of the medium in question. With water "a" — Constant $V^{0,85}$. Thus it is very important to know, that the heat transmission increases with the high flow velocity. Furthermore, a high flow velocity will reduce the forming of scales on the heater surfaces. But the resistance against the flow, that is the drop of pressure in the heater, will increase with the velocity, the resistance being about proportional to V^2 at a given liquid and a given apparatus. Thus the resistance equals $C \times V^2$ where the coefficient C is depending on the apparatus only. Now we see how important it really is to design an exchanger with the smallest possible resistance against flow at a given velocity. With the spiral heat exchanger we succeeded in solving this problem. There we have no repeated abrupt turns of the media, no ineffective frictional surfaces.

The spiral heat exchanger, Fig. 3, consists of two sufficiently long metal strips wound up in a spiral thus forming two canals, one for the heating and one for the cooling medium. If the flowing media are two liquids, the heating medium enters at 3 through the center of the apparatus and leaves at the periphery at 4. The liquid to be heated entering at C runs into the outer passage and is led out at the center at 2. As to be seen, the contraflow principle is perfectly utilized. The sides of the two canals are closed by packings easily removed. The surfaces are then accessible for cleaning from both sides. With stainless material, however, cleaning is very seldom necessary.

Fig. 4 shows a spiral plant for heating fresh water in a Rosenblad system at a Swedish kraft mill.

The plant consists of two spiral exchangers, each of them 860 sq. ft., 1,000 gals./min. of fresh water is heated from 59-158 deg. F. cooling 1320 gals./min. hot water from 192-116 deg. F. These apparatus have been working about three years without any corrosions to mention.

Fig. 5 shows a waste cooler of 1150 sq. ft. for a sulphite mill and a 54 sq. ft. water heater for a Swedish hospital.

The waste cooler cools 11,900 gals./hr. from 203-86 deg. F. by heating 11,900 gals./hr. from 50-167 deg. F. Resistance to flow about 14 lbs./sq. in. on each side. Length—3 feet 11½ inches. The weight—3.45 short tons. The apparatus of 54 sq. ft. heats 1330 gals./hr. water from 147-192 deg. F. by cooling the same quantity of water from 221-176 deg. F. The resistance to flow is 6.6 ft. water colum on each side. Length —1 ft. 2 3/16 inches. The weight is 970 lb. and the test pressure is 128 lb./sq. in.—3/16 inch iron plate.

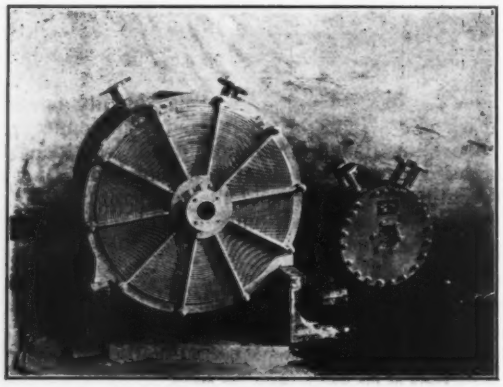

Fig. 5.

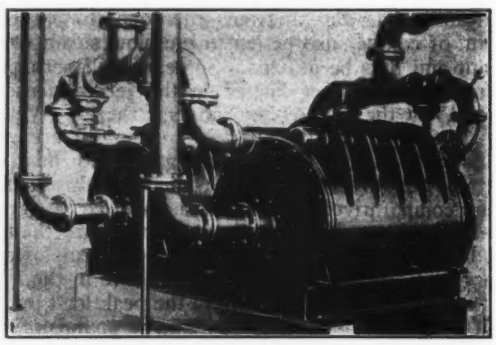

Fig. 4.

The spiral heat-exchanger is, however, not used only for liquid to liquid. It has also found a great use as a steam condenser and gas cooler.

Fig. 6 shows three condensers in the evaporation plant at the sulphate mill in Finland. Only half of the plant is to be seen in the picture. The upper ones have each a cooling surface of 540 sq. ft. The one below 376 sq. ft. This plant is the first known, where the total quantity of steam from the evaporation plant is condensed in surface condensers. That is, we have here 100% recovery of waste steam.

Fig. 7 illustrates the principles of the spiral preheater liquid to liquid *a*, a gas cooler of cross current type *b* and another gas cooler of combined counter and cross current type *c*.

The spiral heat exchanger is a most effective one. The heat transmission coefficient k by liquid to liquid varying between 325 and 650 B.t.u. per sq. ft./deg. F./hr. according to the velocities, temperatures and resistances to flow. For steam condensers we have also used k values of about 600. Concerning the steam gas coolers, the k value is strongly influenced by the percentage of gas in the steam.

As already mentioned the spiral heat exchanger has found a great use in many industries. Until now we have delivered or contracted 170,000 sq. ft. heating surface, about half of that amount being acid proof.

The number of whole heat recovery and SO_2 recovery plants of the Rosenblad storage system is 35 for sulphate and 8 for sulphite.

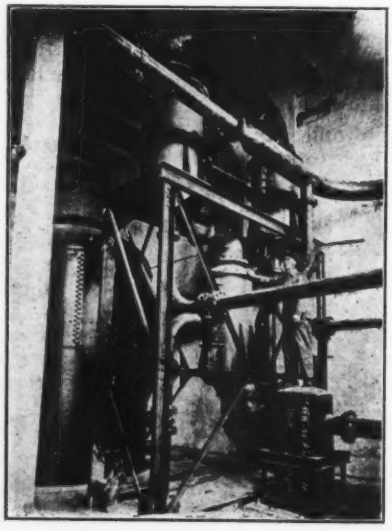

Fig. 6.

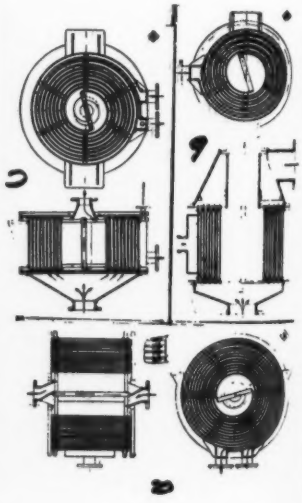

Fig. 7.

News of the Philadelphia Industry

Trend in Favor of Larger Use for Soft-Textured Bond and Book Papers Increasing — Ruberoid Co. Acquires Modern Gold Seal Asphalt Roofing Plant—Light Corrugated Box Purchases Eight-Acre Building Tract.

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., September 20, 1937—With a decided trend towards opaque papers experienced each week, Wilcox, Walter, Furlong Paper Company, exclusive agents for Mor-Opaque line, has stocked both bond and book paper sizes, and, quoted in both bond and paper basis weights 20 and 24. The new sheet is expected to find favor as vellum and uncoated book, as well as bond. Under any of these classifications, Mor-Opaque is believed to offer the characteristic which its name implies, and be suitable for both letterpress and offset printing.

A demonstration folder has been produced to emphasize the adaptability of the sheet under letterpress usage, indicating excellent presswork with halftone screens as fine as 120 and perfect application of flat tint blocks and line cuts. Printed on one side, examination of the reverse, reveals no show-through of halftones and only slight penetration of the solid blocks. The paper has the soft feel, notably present in sheets containing liberal loadings of the more effective opaquing materials, which soft texture paper, long popular in Europe, is rapidly gaining favor in this country.

The Mor-Opaque line is stocked in white only and in the following sizes: 22 x 34; 25 x 38; 32 x 44; 34 x 44; and 35 x 45.

Ruberoid Acquires Gold Seal Asphalt

The Ruberoid Company, manufacturers of asphalt and asbestos building products, which maintains two plants in Erie under the name of the Watson Paper Company, will acquire the physical assets of the Gold Seal Asphalt Roofing Company, operating at Minneapolis, Minn., a modern plant of asphalt roofing and shingles, it was announced during the week. Title to the property will be taken December 1.

Light-Corrugated Box Expands

Light Corrugated Box Company, located for many years at Trenton avenue and Wenango street, has just acquired a tract about eight and one-half acres, bounded by Decatur, Edmunds, Tulip and Shelmire streets, with buildings erected thereon containing a total of 72,000 square feet with frontage of 1,000 feet on Pennsylvania Railroad. The buildings were originally constructed by the Bessemer Motor Truck Company, but never occupied by them.

Philadelphia Paper Association Meet

The Philadelphia Paper and Cordage Association held its first fall meeting September 17, in the Rose Room of the Adelphia Hotel. Due to the illness of President E. K. Lay, who was confined to bed with a severe cold, James Andrews, vice-president, presided. Plans were discussed for the Golf Outing to be held at the Roxborough Country Club on September 23.

Pulp Shipments Show Increases

PORTLAND, Me., September 21, 1937—Shipment through this port of 38,728 tons of wood pulp consigned to nearly every country in the world, during the first eight months of 1937, was announced today by the Brown Company.

This tonnage not only exceeds by 7,000 tons the exports of the company for the full year 1936, but is nearly double the amount shipped for the corresponding period a year ago, which amounted to 19,472 tons. It exceeds by 14 times the quantity exported in the boom year of 1929, when 2,733 tons were shipped.

Close observers of trends in the pulp and paper industry cite these figures as supporting approval of the reorganization plan recently filed by the company with the Federal court at Portland, Me. The plan states that demand for its products currently exceeds production capacity by fifty per cent. Pointing to the steadily increasing demand registered by the world rayon industry as an indication of the pulp industry's stability and promising future, the management of the Brown Company in filing its plan stated that $12,500,000 in new money for working capital and expansion was assured as soon as the court approves the plan.

Clyde A. Benson Engaged by Delthirna

The American Delthirna Corporation announces the appointment of Clyde A. Benson as sales engineer.

Mr. Benson is well qualified to direct the sales and installation of Delthirna Size units. He was graduated from the Massachusetts Institute of Technology in 1922, receiving the degree of S.B. in chemical engineering.

Entering the paper industry as a chemist, his subsequent research work, and mill experience on sizing problems have made it possible for him to bring to his new position a competent knowledge of the sizing of paper. Since his graduation, Mr. Benson has been connected with Brown Company at Berlin, N. H., the S. D. Warren Company at Cumberland Mills, Me., Oxford Paper Company at Rumford, Me. and New York City, and Oxford-Miami Paper Company at West Carrollton, Ohio.

W. M. Crane for Lieut. Governor

[FROM OUR REGULAR CORRESPONDENT]

DALTON, Mass., September 21, 1937.—Winthrop M. Crane, Jr., son of the late W. Murray Crane, head of the Crane paper mills in this town for many years is being strongly mentioned as the next Republican candidate for Lieutenant-Governor of the state. The movement is said to have strong backing on the part of Republican business men and manufacturers and with the idea in mind of the possibility of his being the Republican candidate for Governor in 1940, Mr. Crane has been approached before by influential men who desired him to become a candidate.

Indianapolis Demand Expanding

[FROM OUR REGULAR CORRESPONDENT]

INDIANAPOLIS, Ind., September 20, 1937.—With the change in seasons, the wholesale paper market here showed a favorable reaction during the last week. While the actual fall business has not developed to the full seasonal volume, the number of inquiries for all lines has increased and orders will follow soon, in the opinion of leaders of the trade.

The opening of all schools has aided in demand for fine papers of all sorts and a good volume of direct mail advertising has created an increasing demand for covers and book papers. Printers say there is more direct mail work in prospect for later in the fall than there has been for some time.

Box factories also are increasing their production. At the present time there is less labor trouble among users of paper containers than there has been since the CIO came into prominence. This is particularly true in the automobile accessory and the textile fields, both of which are large users in this territory of paper containers. The hardware field also has shown signs of taking more stock. Prices are continuing firm. Some manufacturers already have begun to think of the holiday trade.

In the common paper field, demand for wrapping paper and bags continues good. Demand for building papers and roofing has slumped somewhat, but prospects are good for a fall demand. Jobbers in these lines generally have small but well balanced stocks.

Newsprint continues to move steadily. Reports from local jobbers indicate that papers in the smaller communities have been particularly well favored by rising commodity prices in the agricultural field and point to their increased lineage to substantiate this belief.

The general tone of the wholesale paper stock market here is steady. High grade rags are moving readily with low grade stock somewhat lagging. Prices on waste paper are firm with mill demand reported slightly on the upgrade.

Stebbins Corp. Formed in Washington

The Stebbins Engineering and Manufacturing Company announces the formation of a wholly owned subsidiary, Stebbins Engineering Corporation, in the State of Washington, to better serve its customers.

There will be no change in personnel or policy or service. The West Coast operations of Stebbins will simply be carried on as heretofore under the management of A. S. Quinn, who will continue to maintain the corporation office at 1201 Textile Tower, Seattle.

The parent company has substantially enlarged its Technical Service Department, centralized at Watertown, N. Y. This technical service is completely available to its operating subsidiaries and direct to customers.

The transfer of current Pacific Coast business has already been effected, and the customers and suppliers of Stebbins Engineering and Manufacturing Company in that territory have been requested to deal with Stebbins Engineering Corporation.

Simplified Practice on Asbestos

The Standing Committee in charge of Simplified Practice Recommendation R19-28, Asbestos Paper and Asbestos Millboard, has approved a revision of the recommendation, and the Division of Simplified Practice of the National Bureau of Standards has mailed copies to all interests for consideration and approval.

The original recommendation, which was approved at a general conference of producers, distributors and users in 1924, established a simplified schedule of weights, widths, weight per 100 square feet, and thicknesses of asbestos paper in rolls, and sheet sizes and thicknesses of asbestos millboard.

The original recommendation was effective on September 1, 1924, and has been revised twice and reaffirmed twice since that time.

The proposed revision, which is the third, applies only to asbestos millboard by the addition of one thickness of sheet.

Mimeographed copies of the proposed revision may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

Using Hardwoods for Pulp

The Brown Company, Berlin, N. H., has perfected a process for the recovery of cellulose from hardwoods, such as maple, birch and beech, and will utilize it at its local mills. The process is the result of many months of research in company laboratory, followed by actual mill trials, and will permit the successful commercial use of such woods as noted in the future. On present production schedule, the company is turning out about 200 tons of wood fiber daily, of which more than one-half is being used for rayon manufacture, the remainder being employed in the paper industry.

Alexander Thomson on Advisory Council

[FROM OUR REGULAR CORRESPONDENT]

DAYTON, Ohio., September 20, 1937.—Alexander Thomson, of Hamilton, chairman of the Board of the Champion Paper and Fibre Company, and who also is president of the Ohio Chamber of Commerce, and A. F. Dawson, of Cincinnati, were named as representatives of employers to serve two and five-year terms, respectively, as members of the Advisory Council to the State Unemployment Compensation Commission, by Governor M. L. Davey, the latter part of last week.

Each of the members will receive $20 daily when the Council meets, but not to exceed $2,000 a year and necessary expenses.

Japan Imports More Sulphite Pulp

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., September 8, 1937—Imports of sulphite pulp into Japan during June consisted of 16,000 short tons for the manufacture of paper and 27,500 tons for the manufacture of rayon, according to a recent report from Commercial Attache Frank S. Williams at Tokyo. The total shows a decline of 10 per cent under the May receipts but an increase of 71 per cent compared with the same month a year ago. Imports during the first half of the year were 34 per cent higher than during the first half of 1936, with the United States supplying 37.8 per cent of the 1937 total.

Imports of Paper and Paper Stock

Giving Manifests of New York, Boston, Philadelphia and Other Ports, of Newsprint, Wrapping, Writing, Coated, Blotting, Tissue, Strawboard, Wallboard, Cigarette Papers, Sulphite, Kraft and Ground Wood Pulp.

New York Imports

WEEK ENDING SEPTEMBER 18, 1937

Cigarette paper ..... 494 cs.
Wall paper ..... 11 cs.
Paper hangings ..... 2 bls., 4 cs.
Wall board ..... 2,711 bdls.
Newsprint ..... 9,472 rolls
Printing paper ..... 75 rolls, 42 bls., 44 cs.
Wrapping paper ..... 59 cs.
Packing paper ..... 5 cs.
Filter mass ..... 100 bls.
Filter paper ..... 1 cs.
Drawing paper ..... 2 cs.
Bristol boards ..... 5 cs.
Surface coated paper ..... 93 cs.
Metal coated paper ..... 28 cs.
Decalcomania paper ..... 30 cs., 27 drums (duplex)
Tissue paper ..... 1 cs.
Blotting paper ..... 2 cs.
Writing paper ..... 7 cs.
Card boards ..... 3 cs.
Miscellaneous paper ..... 50 cs.

CIGARETTE PAPER

American Tobacco Co., *Schodack,* Bordeaux, 401 cs.
R. J. Reynolds Tobacco Co., *Pr. Harding,* Havre, 93 cs.

WALL PAPER

———, *American Merchant,* London, 1 cs.
———, *Pr. Harding,* Havre, 10 cs.

PAPER HANGINGS

W. H. S. Lloyd & Co., *American Merchant,* London, 2 bls., 4 cs.

WALL BOARD

Treetex Corp., *Argosy,* Horneborg, 2711 bdls.

NEWSPRINT

International Paper Co., *Arizpa,* Dalhousie, 3674 rolls.
International Paper Sales Co., *Arizpa,* Dalhousie, 2446 rolls.
International Paper Co., *G.T.D.,* Gatineau, 308 rolls.
International Paper Co., *International No. 1,* Gatineau, 313 rolls.
International Paper Co., *A.C.D.,* Donnacona, 311 rolls.
Jay Madden Corp., *Berlin,* Bremen, 707 rolls.
Jay Madden Corp., *Washington,* Hamburg, 313 rolls.
Jay Madden Corp., *Pr. Harding,* Hamburg, 138 rolls.
N. Y. Evening Journal, *Pr. Harding,* Hamburg, 326 rolls.
H. G. Craig Co., *Donpaco,* Donnacona, 307 rolls.
H. G. Craig Co., *G.D.D.,* Donnacona, 315 rolls.
H. G. Craig Co., *Kermic,* Donnacona, 314 rolls.

PRINTING PAPER

Steiner Paper Corp., *Berlin,* Bremen, 29 cs.
Steiner Paper Corp., *Veendam,* Rotterdam, 15 cs.
Jay Madden Corp., *Pr. Harding,* Hamburg, 42 bls., 75 rolls.

WRAPPING PAPER

Keller Dorian Paper Co., *Excambion,* Marseilles, 9 cs.
J. P. Heffernan Paper Co., *Excambion,* Genoa, 50 cs.

PACKING PAPER

Phoenix Shipping Co., *Berlin,* Bremen, 5 cs.

FILTER MASS

A. W. Fenton Co., Inc., *Berlin,* Bremen, 100 bls.

FILTER PAPER

———, *Pr. Harding,* Havre, 1 cs.

DRAWING PAPER

Keuffel & Esser Co., *American Merchant,* London, 1 cs.
Favor Ruhl & Co., *Pr. Harding,* Havre, 1 cs.

BRISTOL BOARDS

Keuffel & Esser Co., *American Merchant,* London, 2 cs.
Favor Ruhl & Co., *American Merchant,* London, 3 cs.

SURFACE COATED PAPER

Gevaert Co. of America, *Westernland,* Antwerp, 81 cs.
———, *Westernland,* Antwerp, 12 cs.

METAL COATED PAPER

K. Pauli Co., *Berlin,* Bremen, 28 cs.

DECALCOMANIA PAPER

B. F. Drakenfeld & Co., *Franconia,* Liverpool, 30 cs., 27 drums (duplex).

TISSUE PAPER

B. F. Drakenfeld & Co., *Franconia,* Liverpool, 1 cs.

BLOTTING PAPER

J. & H. Berge, *Franconia,* Liverpool, 2 cs.

WRITING PAPER

Japan Paper Co., *Washington,* London, 3 cs.
Globe Shipping Co., *Pr. Harding,* Hamburg, 4 cs.

CARD BOARDS

Metropolitan Imp't'g & Manfg. Co., *Pr. Harding,* Hamburg, 3 cs.

MISCELLANEOUS PAPER

T. N. Fairbanks Co., *Gen'l. Pershing,* Yokohama, 9 cs.
Moller Products Corp., *Norden,* Yokohama, 10 cs.
Japan Paper Co., *Niel Maersk,* Kobe, 31 cs.

RAGS, BAGGING, ETC.

———, *Norden,* Kobe, 50 bls. cotton waste.
Spaulding Fibre Co., *Black Heron,* Rotterdam, 170 bls. rags.
Irving Trust Co., *Caledonia,* Glasgow, 41 bls. paper stock.
———, *American Merchant,* London, 29 bls. rags, 77 bls. waste strings.
J. Cohen & Son Co., Inc., *Franconia,* Liverpool, 16 bls. paper stock.
———, *Franconia,* Liverpool, 52 bls. rags.
E. J. Keller Co., Inc., *Schodack,* ———, 126 bls. rags.
R. Blank, *Schodack,* Havre, 146 bls. rags.
Harris Goldman Co., *Schodack,* Havre, 57 bls. bagging.
Irving Trust Co., *Schodack,* Havre, 51 bls. new cuttings.
D. M. Hicks, Inc., *Schodack,* Havre, 46 bls. rags.
Chase National Bank, *Schodack,* Bordeaux, 151 bls. rags.
Banco Coml Italiane Trust Co., *Schodack,* Bordeaux, 166 bls. rags.
Banco Coml Italiane Trust Co., *Westernland,* Antwerp, 131 bls. jute waste.
Chase National Bank, *Westernland,* Antwerp, 101 bls. flax pulp.
Philadelphia Natl. Bank, *Westernland,* Antwerp, 95 bls. rags.
E. J. Keller Co., Inc., *Westernland,* ———, 254 bls. bagging.
S. Shapiro & Sons, Inc., *Niel Maersk,* Kobe, 46 bls. rayon waste.
E. J. Keller Co., Inc., *Extavia,* ———, 304 bls. rags.
Irving Trust Co., *Camamu,* Rio, 30 bls. rags.
W. Steck & Co., *Excambion,* Alexandria, 503 bls. rags, 160 bls. bagging.
Hicks Costarino Co., Inc., *Excambion,* Alexandria, 52 bls. rags, 51 bls. bagging.
R. J. Ross Co., Inc., *Excambion,* Alexandria, 199 bls. bagging.
———, *Excambion,* Alexandria, 156 bls. bagging, 490 bls. rags.
R. Blank, *Excambion,* Alexandria, 80 bls. rags, 154 bls. old cottons.
Castle & Overton, Inc., *Excambion,* Alexandria, 48 bls. rags, 164 bls. bagging.
Keene, Inc., *Excambion,* Alexandria, 38 bls. bagging.
E. J. Keller Co., Inc., *Excambion,* ———, 111 bls. paper stock.
E. J. Keller Co., Inc., *Pr. Harding,* ———, 132 bls. paper stock.
E. J. Keller Co., Inc., *Black Tern,* ———, 55 bls. bagging.
Irving Trust Co., *Fernlane,* Algiers, 75 bls. chiffons.
———, *Fernlane,* Algiers, 150 bls. chiffons.

GLUE STOCK, ETC.

Milligan Higgins Corp., *Argosy,* Gdynia, 98 bls. glue stock.
———, *Vulcania, Trieste,* 825 bags bone glue.

OLD ROPE

Darmstadt Scott & Courtney, *Norden,* Kobe, 100 coils.
W. Steck & Co., *Spaarndam,* Rotterdam, 71 bls.

Banco Coml Italiane Trust Co., *American Merchant,* London, 184 coils.
Banco Coml Italiane Trust Co., *Bajamar,* London, 111 bls.
D. Benedetto, Inc., *Cypria,* Marseilles, 42 rolls.
Continental Bank Trust Co., *Pr. Harding,* Hamburg, 132 coils.

CHINA CLAY

English China Clays Sales Corp., *Franconia,* Liverpool, 160 bags.

WOOD PULP

Perkins Goodwin & Co., *Pilsudski,* Gdynia, 1200 bls. wood pulp, 184 tons.
Johaneson Wales & Sparre, Inc., *Argosy,* Sundsvall, 1375 bls. sulphite, 275 tons.
Mead Sales Co., Inc., *Argosy,* Sundsvall, 315 bls. sulphite, 63 tons.
Tradesmans Natl Bank Trust Co., *Argosy,* Norrsundet, 750 bls. sulphate, 172 tons.
Gottesman & Co., Inc., *Argosy,* Hernosand, 5400 bls. sulphate, 900 tons.
Bulkley Dunton Pulp Co., Inc., *Argosy,* ———, 600 bls. kraft sulphate, 100 tons.
Guaranty Trust Co., *Barbarigo,* Trieste, 249 bls. wood pulp.
———, *Barbarigo,* Trieste, 1625 bls. wood pulp.
Absorbo Beer Pad Co., *Vulcania,* Trieste, 367 bls. wood pulp.

WOOD PULP BOARDS

Flexideal Dry Mat Co., *Washington,* Hamburg, 60 cases.

ALBANY IMPORTS

WEEK ENDING SEPTEMBER 18, 1937

International Paper Co., *Vindeggen,* Chatham, N. B., 1800 cords pulpwood.

BOSTON IMPORTS

WEEK ENDING SEPTEMBER 18, 1937

Castle & Overton, Inc., *Black Heron,* Rotterdam, 216 bls. wood pulp, 43 tons.
———, *Black Heron,* Rotterdam, 94 rolls straw boards.
———, *Black Heron,* Antwerp, 17 bls. rags.
American Express Co., *Black Heron,* Antwerp, 86 rolls newsprint.
D. M. Hicks Co., Inc., *Black Heron,* Antwerp, 114 bls. flax paste.
T. D. Downing & Co., *Black Heron,* Antwerp, 65 bls. rags.
E. J. Keller Co., Inc., *Black Heron,* ———, 61 bls. bagging.
———, *Ida,* Trieste, 637 bls. wood pulp.
Gottesman & Co., Inc., *Hjelmaren,* Sweden, 3000 bls. sulphite.
Parsons & Whittemore, Inc., *City of Flint,* ———, 391 bls. wood pulp.

PHILADELPHIA IMPORTS

WEEK ENDING SEPTEMBER 18, 1937

———, *City of Delhi,* Sydney, 58 coils old rope.
———, *Ida,* Trieste, 400 bags bone glue.
Union Waste Co., *Schodack,* Bordeaux, 61 bls. rags.
Castle & Overton, Inc., *Schodack,* Bordeaux, 197 bls. rags.
E. J. Keller Co., Inc., *Schodack,* ———, 349 bls. rags.
———, *Schodack,* Havre, 4 cs. wall paper.
J. T. Flannery, *Schodack,* Havre, 48 bls. rags.
National City Bank, *Schodack,* Havre, 18 bls. cotton waste.
Castle & Overton, Inc., *Schodack,* Havre, 90 bls. rags.
Castle & Overton, Inc., *Schodack,* St. Nazaire, 252 bls. rags.
M. Sone, *Wasgenwald,* Hamburg, 1534 bls. wood pulp.

BALTIMORE IMPORTS

WEEK ENDING SEPTEMBER 18, 1937

Congoleum Nairn Co., *Schodack,* Bordeaux, 201 bls. rags.
Congoleum Nairn Co., *Schodack,* Havre, 30 bls. rags.
Sherman Bros., *Niel Maersk,* Kobe, 120 bls. rags.
Price & Pierce, Ltd., *Tortugas,* ———, 3600 bls. unbleached sulphite.
Gottesman & Co., Inc., *Tortugas,* Sweden, 1500 bls. sulphite.
Gottesman & Co., Inc., *Rydboholm,* Sweden, 2400 bls. sulphate; 250 bls. sulphite.

NORFOLK IMPORTS

WEEK ENDING SEPTEMBER 18, 1937

E. J. Keller Co., Inc., *Schodack,* ———, 49 bls. rags.
N. Y. Trust Co., *Schodack,* Havre, 130 bls. bagging.
National City Bank, *Niel Maersk,* Kobe, 400 bls. bagging.
Price & Pierce, Ltd., *Tortugas,* ———, 6060 bls. unbleached sulphite.
Gottesman & Co., Inc., *Tortugas,* Sweden, 6900 bls. sulphite.

GALVESTON IMPORTS

WEEK ENDING SEPTEMBER 18, 1937

Burka Bagging Co., *Norden,* Kobe, 130 bls. bagging.

Specification for Writing Papers

Of the many requests from consumers received by the National Bureau of Standards for assistance in the formulation of purchase specifications for papers, a large volume have to do with record papers, particularly writing. In view of this a suggested specification in detail for manifold bond, and ledger paper was formulated and it has been distributed on request. For the information of those who may be using the suggested requirements, and others who may be interested, the Bureau announces that a revised and more complete specification has been prepared at the request of the National Association of Purchasing Agents, for the information of their members.

The specification covers the characteristics of writing papers ranging from permanent record papers to those for temporary use. The papers are divided into 2 grades according to strength. The primary classification is based on the stability of the paper and is irrespective of the source of the fiber. The stability is defined to limits in decrease in folding endurance, decrease in alpha cellulose, and increase in copper number, on heating for 72 hours at 100 degs. C.

Illustrative uses of the various classes and references to appropriate test methods are included.

The specification is based on the results of extensive investigation of record papers in the paper section of the Bureau, practical experience of members of the section in the industry, and advice received from some of the writing paper manufacturers.

Crane Paper Stock Valves

A new line of valves designed especially for controlling the flow of pulp stock in pulp and paper mills, has been announced by the Crane Co., 836 So. Michigan avenue, Chicago. They are made and recommended for low pressure service of not over 60 pounds water, such as prevails on pulp lines. The conventional type wedge gate valve is not satisfactory for lines conveying pulp stock, because the stock packs between the seats and under the disc, causing expensive shut-downs before the valves, and other parts of the piping system, can be taken apart and cleaned, and the flow started again.

This new line of valves is stated to be the result of several years of research and experimentation, including operation in actual field service. The body is made in two halves, bolted together, with cleanout provided on the bottom. Each valve body has six threaded and plugged openings, two on each side and two on the bottom, so that when necessary a water supply pipe can be connected to these openings to flush the inside of the valve and the pipe line.

West Virginia Pulp and Paper Company

230 Park Ave. New York
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Public Ledger Building, Philadelphia, Pa.

Manufacturers of

ENGLISH FINISH SUPERCALENDERED
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KRAFT WRAPPING AND KRAFT ENVELOPE.
KRAFT CYLINDER BOARD.
BLEACHED SULPHITE AND SODA PULP.
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Covington, Virginia
Tyrone, Pennsylvania
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All kinds and styles of Felts for all kinds and styles of Papers.

Write us about your Felt problems and let us help you reduce your Felt Costs—we will call anywhere at any time.

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CANTON, MASS.

Woolen manufacturers since 1856

WOOD PULP AGENTS

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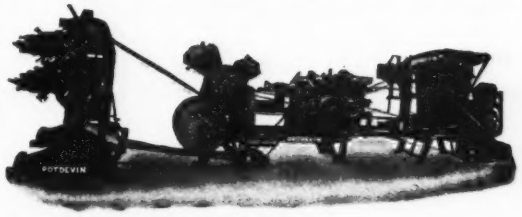
POTDEVIN



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Self-Opening Square Paper Bag Machine

For over 40 years our customers' desires have been our guide. We have worked hand in hand, ever seeking a better method, a finer job.

Numerous new machines, new combinations, many improvements, have resulted from this coalition.

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LATEST MARKET REVIEW

New York Market Review

Office of the PAPER TRADE JOURNAL,
Wednesday, September 22, 1937.

The paper markets report a moderate demand for the current week. Volume continued to fall short of expectations but in general, the trade looks forward to an improved demand at satisfactory price levels for this fall.

The newsprint market continues active with a good volume moving under contract. Bond and ledgers are reported as moving rather slowly under a slightly reduced consumer demand and with dealers reluctant to enter the market until their inventories are further reduced.

The box board markets continue to reflect the slightly less than seasonable demand which has prevailed for some weeks. Prices are firm in East and West and the trade is optimistic of the future.

Chemical Pulp

The chemical pulp market is moderately active. The volume in the imported grades of pulp continues rather limited. The slight slowing down in box board production is stated to be a factor in the current condition of the market. No noteworthy change in domestic or foreign quotations is reported and prices conform to the levels of last week.

Mechanical Pulp

The mechanical pulp market continues at about the moderate level of the preceding week. Prices are firm and unchanged.

Old Rope and Bagging

No increase in the demand for old rope and bagging is reported for the current week. The volume of business is rather light. Prices hold firm, without change from the quotations of last week.

Rags

The rag market reports demand as steady with prices firm and unchanged at the levels of the preceding week.

Waste Paper

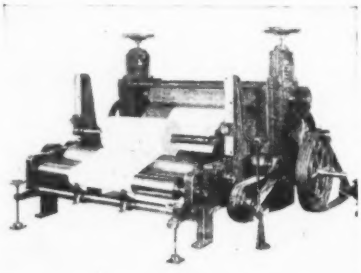
The demand for waste paper is reported as steady. No change in prices are reported for the current week. The expected improvement in demand for mixed paper, which normally occurs at this season, has not as yet set in. The demand for folded news continues rather slow.

Twine

Moderate activity prevails in the twine markets. No noteworthy change in the prices of sisal, jute or manila are reported in the trade. Trading in cotton twine continues at prevailing levels, with quotations unchanged.

Ship Embosser To Norway Mill

During this month the Paper Converting Machine Company, Green Bay, Wis., manufacturer of paper converting machinery, will ship to Moss, Norway, the 50-inch Embosser for decorating kraft paper, illustrated here, to a paper mill founded in 1806. This machine is being shipped with two complete sets of rolls representing two distinct designs. It is anti-friction bearing equipped, and the embossing unit carries a 2-time paper roll. In the operation of the machine, the web after embossing is wound on a drum winder so that the product is available for other converting machines. The rolls are so arranged to be quickly renewed and additional sets put into the machine.



John H. DeVitt Speaks To Cost Men

[FROM OUR REGULAR CORRESPONDENT]

SPRINGFIELD, Mass., September 21, 1937.—The Springfield Chapter of the National Association of Cost Accountants opened its season Wednesday with a meeting at the Springfield Country Club. The afternoon program was given up to golf with dinner at 6:15, the guest speaker being John H. DeVitt, assistant auditor of the Hammermill Paper Company of Erie, Pa., who spoke on "Control of Capital Assets." Among those attending were Clayton R. Harvey of the National Blank Book Company, Arthur R. Ingham, Franklin Paper Company; Ralph H. Morrill, Chemical Paper Manufacturing Company; John Pauly Hamden, Glazed Paper and Card Company; Godfrey D. Porter, Crocker-McElwain Company, and George W. Webster of the Marvellum Paper Company.

Walter B. Sheehan Convalescing

Walter B. Sheehan, treasurer of the Missisquoi Corporation, is convalescing at his home in Holyoke from an attack of pneumonia and a streptococci sore throat. His condition is very favorable now.

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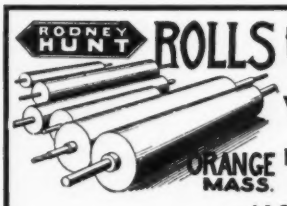

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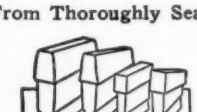

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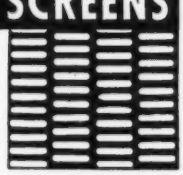

Miscellaneous Markets

Office of the PAPER TRADE JOURNAL,
Wednesday, September 22, 1937.

BLANC FIXE—The demand for blanc fixe continued steady during the current week. Prices were firm and unchanged from the preceding week. Quotations of the pulp ranged from $42.50 to $45 per ton, in bulk. The price of the powder is quoted at from 3½ to 3¾ cents per pound, in barrels, at works.

BLEACHING POWDER—The bleaching powder market was reported as seasonably active, with the contract movement normal. Prices are firm and unchanged from the quotations of last week. Bleaching powder is offered at from $2 to $2.25 per 100 pounds, in drums, at works.

CASEIN—The demand for casein continued steady, with no price change reported for the week. Domestic standard ground casein is quoted at 13½ cents per pound; domestic finely ground casein at from 13½ to 14 cents per pound, all in bags, car lot quantities.

CAUSTIC SODA—The caustic soda market was seasonably active, with the contract movement normal. Prices continued firm, with no change reported from last week. Solid caustic soda is quoted at from $2.10 to $2.30; the flake and ground ranging from $2.50 to $2.70 per 100 pounds, in drums, at works.

CHINA CLAY—The demand for china clay continued good. The active movement of the contract volume is reported as satisfactory. The imported clay, representing many grades, is quoted at from $14.50 to $25 per ton, ship side. The domestic clay market continued strong. The prices of domestic filler clay ranged from $6.50 to $12 per ton, while coating clay was quoted at from $11 to $22 per ton, at mines.

CHLORINE—The chlorine market continued seasonably active. The demand was good and prices firm, with quotations unchanged from the preceding week. Chlorine is quoted at $2.15 per 100 pounds, in single-unit tank cars, at works.

ROSIN—The demand for rosin continued good, with a slight increase in prices for the week in paper making rosin and the seventy per cent size, while wood rosin was slightly lower. Paper making rosin is quoted at $7.87½, and wood rosin at $7.90 per 280 pounds, gross weight, in barrels at Savannah. Seventy per cent rosin size is quoted at $3.61; per 100 pounds, in tank cars, at works.

SALT CAKE—The demand for salt cake continued steady with prices firm. Quotations ranged from $12 to $13; chrome salt cake is quoted at from $10 to $11, f.o.b., shipping point. Imported salt cake is selling at $12, Gulf or Atlantic Seaboard, on dock.

SODA ASH—The soda ash market continued active, with a steady demand from paper mills. Prices are quoted at the same levels as the preceding week. Quotations in car lot, at works, per 100 pounds are as follows: in bulk, $.90; in bags, $1.05; and in barrels, $1.35.

STARCH—The starch market was moderately active for the current week. Prices continued to show a tendency to slightly lower levels, in view of the best corn crop in many years. Paper making starch is quoted at $3.45 per 100 pounds, in barrels, car lots, f.o.b., Chicago.

SULPHATE OF ALUMINA—The condition of the sulphate of alumina market continued good, with contract shipment moving in seasonable volume. Prices continued firm, at the prevailing quotations of last week. Commecial grades are quoted at from $1.25 to $1.60, while iron free is quoted at from $2 to $2.25 per 100 pounds, in barrels, at works.

SULPHUR—The sulphur market continued firm. Prices are unchanged at former levels. Annual contracts are quoted at $18 per long ton, f.o.b., cars at mines.

Market Quotations

Paper

Tissues—Per Ream—

White No. 1	1.10	@	—
White No. 1 M. G.	1.07½	@	—
White No. 1½	.77½	@	—
White No. 2	.75	@	—
Anti-Tarnish M. G.	.77½	@	—
Colored	.90	@	—
Kraft	.77½	@	—
Manila	.75	@	—
Unbleached Toilet	2.90	@	3.30
Bleached Toilet	3.94	@	5.26

Paper Towels—

Unbleached	2.10	@	3.35
Bleached	3.30	@	3.70

Manila—

No. 1 Jute	9.00	@	9.25
No. 2 Jute	7.75	@	8.50
No. 1 Wood	4.00	@	5.25
No. 2 Wood	3.50	@	4.00

Fibre Papers—

No. 1 Fibre	4.25	@	5.50
No. 2 Fibre	4.00	@	4.75

(Delivered New York)

News, per ton—

Roll, contract	42.50	@	—
Sheets	47.50	@	—

Kraft—

No. 1 Northern	5.25	@	5.75
Standard	5.00	@	—
Southern	4.50	@	—
Machine glazed, plain, striped	5.00	@	—

Boards, per ton—

Chip	42.50	@	—
News	45.00	@	—
Sgl. Mla. Ll. Chip	55.00	@	—
Jute Lined Chip	55.00	@	—
White Pat. Coated	67 50	@	—
Kraft Liners	55.00	@	—
Binders Boards	75.00	@	80.00

The following are representative of distributors' resale prices:—

Rag Content Bonds and Ledgers—
White, Assorted Items.
Delivered in Zone 1:

	Bonds	Ledgers
100% Rag Ext. No. 1	$41.40@$48.50	$42.55@$50.00
100% Rag	32.80@ 38.50	33.95@ 39.75
85% Rag	.....	32.20@ 37.75
75% Rag	24.75@ 29.00	25.90@ 30.50
65% Rag	21.65@ 26.25	22.80@ 27.75
50% Rag	18.70@ 22.75	19.90@ 24.25
25% Rag	15.80@ 19.25	16.95@ 20.75

Regular Colors @ $1.50 cwt. extra.
Heavy Colors @ $3.00 cwt. extra

Sulphite Bonds and Ledgers—
White, Assorted Items.
Delivered in Zone 1:

	Bonds	Ledgers
No. 1	$9.35@$11.50	$10.55@$12.75
No. 2	8.50@ 10.25	9.65@ 11.75
No. 4	7.60@ 9.25	8.80@ 10.75

Regular Colors @ $1.50 cwt. extra.
Heavy Colors @ $3.00 cwt. extra.

Free Sheet Book Papers—
White, Cased Paper.
Delivered in Zone 1:

No. 1 Glossy Coated	$12.45	@$14.25
No. 2 Glossy Coated	10.80	@ 12.25
No. 3 Glossy Coated	9.65	@ 11.00
No. 4 Glossy Coated	9.05	@ 10.50
No. 1 Antique (water-marked)	9.05	@ 10.50
No. 2 Offset	8.35	@ 9.50
A Grade E. F.	8.20	@ 9.50
A Grade S. & S. C.	8.45	@ 9.75
B Grade E. F.	7.60	@ 8.75
B Grade S. & S. C.	7.85	@ 9.00
C Grade E. F.	7.30	@ 8.50
C Grade S. & S. C.	7.55	@ 8.75
D Grade E. F.	7.00	@ 8.25
D Grade S. & S. C.	7.25	@ 8.50

Ivory & India at $.50 cwt. extra.

Mechanical Pulp

(On Dock, Atlantic Ports)

No. 1 Imported—		
Moist	35.00	@36.00
Dry	40.00	@42.00
(Delivered)		
No. 1 Domestic and Canadian	36.00	@37.50

Chemical Pulp

(On Dock, Atlantic, Gulf and West Coast Ports)

Bleached Sulphite (Domestic and Foreign)—			
Prime Bleached Sulphite	3.50	@	4.65
Prime Qualities— Easy-Bleaching Sulphite	3.50	@	4.00
Strong Unbleached Sulphite	3.00	@	3.65

(On Dock, Atlantic Ports)

Kraft Bleached	4.00	@	4.75
Kraft Light & Strong	3.00	@	3.75
Kraft No. 1	2.90	@	3.65
Kraft No. 2	2.50	@	2.75

(F.o.b. Pulp Mill)

Kraft Domestic	2.00	@	3.10

(Delivered)

Soda Bleached	3.25	@	—

Add 60 cents per short ton, dock charges, for Albany; $2.00 for Lake Ports East and $3.00 for Lake Ports West of Mackinac Straits.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1	9.00	@	9.25
Silesias, No. 1	6.75	@	7.00
New Unbleached	9.25	@	9.50
Blue Overall	7.25	@	7.50
Fancy	3.75	@	4.25
Washables	2.75	@	3.25
Mixed Khaki Cuttings	4.25	@	4.50
O. D. Khaki Cuttings	4.75	@	5.00

Old Rags

White, No. 1—			
Repacked	3.75	@	4.25
Miscellaneous	3.00	@	3.25
White, No. 2—			
Repacked	2.60	@	2.85
Miscellaneous	2.00	@	2.25
Thirds and Blues—			
Repacked	2.00	@	2.25
Miscellaneous	1.90	@	2.00
Roofing Rags—			
No. 1	1.55	@	1.65
No. 2	1.40	@	1.50
No. 3 (bagging)	.90	@	1.00
No. 4	.90	@	1.00
No. 5A	.75	@	.85

Foreign Rags

New Rags

New Dark Cuttings	2.25	@	2.40
New Mixed Cuttings	2.00	@	2.20
New Light Silesias	5.50	@	5.75
Light Flannelettes	5.50	@	5.75
New White Cuttings	7.00	@	7.50
New Light Oxford	4.00	@	4.50
New Light Prints	3.00	@	3.25

Old Rags

No. 1 White Linens	7.50	@	8.50
No. 2 White Linens	6.50	@	7.50
No. 3 White Linens	4.50	@	5.50

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No. 4 White Linens	2.25	@	3.25
No. 1 White Cotton	4.25	@	4.75
No. 2 White Cotton	3.25	@	3.75
No. 3 White Cotton	2.50	@	3.00
No. 4 White Cotton	1.90	@	2.20
Extra Light Prints	2.00	@	2.40
Ord. Light Prints	1.75	@	2.15
Med. Light Prints	1.55	@	1.95
Dutch Blue Cottons	2.25	@	2.50
French Blue Linens	3.00	@	—
Checks and Blues	2.00	@	—
Linsey Garments	2.25	@	2.35
Dark Cottons	2.00	@	—
Old Shopperies	1.75	@	—
New Shopperies	1.75	@	—
French Blues	2.25	@	2.50

Old Rope and Bagging

(Prices to Mill f. o. b. N. Y.)

Gunny No. 1—			
Foreign	2.35	@	2.50
Domestic	2.25	@	2.35
Wool Tares, light	1.75	@	1.85
Wool Tares, heavy	2.35	@	2.45
Bright Bagging	1.70	@	1.75
Manila Rope—			
Foreign	4.75	@	5.00
Domestic	5.00	@	5.25
Jute Strings	2.75	@	3.00
Sisal Strings	2.60	@	2.75
Mixed Strings	Nominal		

Old Waste Papers

(F. o. b. New York)

Shavings—			
White Envelope Cuttings	3.10	@	3.25
Ordinary Hard White No. 1	2.60	@	2.70
Hard White No. 2	2.40	@	2.50
Soft White No. 1	2.30	@	2.40
Flat Stock—			
Stitchless	1.50	@	1.55
Overissue Mag.	1.50	@	1.55
Solid Flat Book	1.20	@	1.25
Crumbled No. 1	.85	@	.95
Ledger Stock	1.55	@	1.60
New B. B. Chips	.45	@	.50
Manila—			
New Env. Cut	2.15	@	2.25
New Cuttings	1.65	@	1.75
Old Kraft Machine—			
Compressed bales	1.55	@	1.65
News—			
No. 1 White News	1.45	@	1.55
Strictly Overissue	.65	@	.75
Strictly Folded	.42½	@	.47½
No. 1 Mixed Paper	.45	@	.50

Twines

(F. o. b. Mill)

(Soft Fibre)			
Coarse Polished—			
India	.16	@	.18½
White Hemp	.17	@	.20½
India Compress	.16½	@	.17
Fine Polished—			
Fine India	.22	@	.24
Unpolished—			
Box	.11¾	@	.12¾
Paper Makers	.11½	@	.13¾
Tube Rope	.12½	@	.15¼
Wall Paper	.13½	@	.14¼
Wrapping	.17	@	.21
Soft Fiber Rope	.15¾	@	—
(Hard Fibre)			
Medium Java	.13½	@	.14
Mex. Sisal	.12	@	.16
Manila	.21	@	.28
Domestic	4.25	@	4.50
Transmission Rope	2.00	@	2.25
Jute Rope	1.85	@	2.12½
Soft Jute Strings	2.00	@	2.50
Jute Carpet Threads	1.75	@	2.00
Gunny No. 1			
Foreign	2.50	@	2.55
Domestic	2.10	@	2.15
Bleachery Burlap	4.00	@	4.25
Scrap Burlap—			
Foreign	2.15	@	2.25
Domestic	1.75	@	1.85
Scrap Sisal	2.25	@	2.30
Scrap Sisal for Shredding	2.40	@	2.50
Wool Tares, heavy	—	@	2.25
New Burlap Cuttings	2.45	@	3.00
Aust. wool pouches	3.25	@	3.50
Heavy bailing bagging	2.50	@	2.70
Paper Mill Bagging	1.70	@	1.75
Bagging No. 2	1.00	@	1.10

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints	.03½	@	.03¾
New White No. 1	.08	@	.08¼
New White No. 2	.06	@	.06¼
New Light Flannelettes	—	@	.06½
Silesias No.	—	@	.06½
New Black Silesias	.04¼	@	.04½
Soft Unbleached	.09	@	.09¼
Blue Cheviot	.07¼	@	.07½
Fancy	.03¾	@	.04
Washable	.03	@	.03¼
Cottons—According to grades—			
Blue Overalls	.07	@	.07¼
New Black, soft	.04¼	@	.04½
Khaki Cuttings	.04½	@	.04¾
O. D. Khaki	.04¾	@	.05
Corduroy	.03¼	@	.03½
New Canvas	.07¾	@	.08¼
B.V.D. Cuttings	.08¾	@	.09

Domestic Rags (Old)

(F. o. b. Boston)

Canvas	.04½	@	—
White No. 1—			
Repacked	—	@	2.75
Miscellaneous	2.50	@	2.75
White No. 2—			
Repacked	1.90	@	2.00
Miscellaneous	2.00	@	2.25
Twos and Blues	1.75	@	2.00
Third and Blues—			
Repacked	1.37½	@	1.75
Miscellaneous	1.25	@	1.62½
Black Stockings	3.90	@	4.00
Roofing Stock—			
No. 1	1.40	@	1.50
No. 2	1.30	@	1.35
No. 3	1.05	@	1.15

Foreign Rags

(F. o. b. Boston)

Dark Cottons	1.65	@	1.85
Dutch Blues	3.00	@	3.15
New Checks and Blues	2.85	@	3.00
Old Fustians	3.00	@	3.25
Old Linsey Garments	2.15	@	2.50
New Silesias	6.50	@	7.00

PHILADELPHIA

Domestic Rags (New)

(Price to Mill, f. o. b. Phila.)

Shirt Cuttings—			
New White, No. 1	—	@	.08
New White, No. 2	.04½	@	.05
Light Silesias	.05½	@	—
Silesias, No. 1	—	@	.05½
Black Silesias, soft	.03	@	.03½
New Unbleached	.08	@	.08½
Washable, No. 1	.02¼	@	.02½
Blue Overall	.05½	@	.06
Cottons—According to grades—			
Washable, No. 2	—	@	.02
New Blue	.01¾	@	.02
Fancy Percales	—	@	.03½
New Black Soft	.03	@	.03½
New Light Seconds	—	@	.05½
New Dark Seconds	1.25	@	1.50
Khaki Cuttings—			
No. 1 O. D.	.04	@	.04½
No. 2 Mixed	—	@	.03
Corduroy	.02¼	@	.03
New Canvas	.06½	@	.07
New Black Mixed	.02	@	.02¾

Domestic Rags (Old)

White No. 1—			
Repacked	3.00	@	3.50
Miscellaneous	2.75	@	3.25
Thirds and Blues—			
Miscellaneous	2.00	@	2.25
Repacked	2.25	@	2.50
Black Stockings (Export)	4.50	@	5.00
Roofing Stock—			
Foreign No. 1	1.75	@	2.00
Domestic No. 1	1.50	@	1.70
Domestic No. 2	1.30	@	1.40
Roofing Bagging	—	@	1.25

Bagging

(F. o. b. Phila.)

Gunny, No. 1—			
Foreign	1.80	@	2.00
Domestic	2.00	@	2.25
Manila Rope	4.25	@	4.50
Sisal Rope	2.00	@	2.25
Mixed Rope	1.00	@	1.10
Scrap—			
No. 1	1.75	@	2.00
No. 2	1.00	@	1.25
Wool Tares, heavy	3.25	@	3.50
Mixed Strings	1.00	@	1.10
No. 1 New Light Burlap	3.00	@	3.50
New Burlap Cuttings	2.00	@	2.25

Old Papers

(F. o. b. Phila.)

Shavings—			
No. 1 Hard White	2.55	@	2.75
No. 2 Hard White	2.40	@	2.55
No. 1 Soft White	2.40	@	2.55
No. 2 Soft White	1.50	@	1.75
No. 1 Mixed	.80	@	.90
Solid Ledger Stock	1.75	@	1.85
Ledger Stock, white	1.60	@	1.70
Ledger Stock, colored	1.35	@	1.45
No. 1 Books, heavy	1.05	@	1.10
Manila Cuttings	1.75	@	1.85
Print Manila	.50	@	.55
Container Manila	.45	@	.50
Kraft Paper	1.30	@	1.40
No. 1 Mixed Paper	.35	@	.45
Straw Board Chip	.40	@	.45
Binders Board Chip	.40	@	.45
Corrugated Board	.50	@	.55
Overissue News	.60	@	.65
Olds Newspapers	.40	@	.45

BOSTON

Old Papers

(F. o. b. Boston)

Shavings—			
No. 1 Hard White	2.25	@	2.40
No. 1 Soft White	1.85	@	2.15
No. 2 Mixed	.75	@	.80
Solid Ledger Books	1.50	@	1.75
Overissue Ledger Stock	1.30	@	1.50
Mixed Ldgers	.85	@	.90
No. 1 Books, heavy	1.00	@	1.10
No. 1 Books, light	.65	@	.75
Crumpled Stitchless Book Stock	.50	@	.60
Manila Env. Cuttings	1.60	@	1.70
Manila Env. Cuttings, extra quality	2.20	@	2.30
No. 1 Old Manila	.95	@	1.00
White Blank News	1.30	@	1.40
No. 1 Kraft	1.75	@	—
Mixed Papers	.42½	@	.47½
Print Manila	.65	@	.70
Container Manilas	.27½	@	—
Old Newspapers	.52½	@	.57½
Overissue News	.60	@	.65
Box Board Chips	.35	@	.40
Corrugated Boxes	.62½	@	.67½
Kraft corrugated boxes	1.20	@	1.22½
Screening Wrappers	.60	@	.65

Bagging

(F. o. b. Boston)

Manila Rope—			
Foreign	4.25	@	4.40

CHICAGO

Old Papers

(F. o. b. Chicago)

Shavings—			
No. 1 White Envelope Cuttings	3.30	@	3.40
No. 1 Hard White	2.60	@	2.70
No. 1 Soft White	2.10	@	2.15
Ledger & Writings	1.40	@	1.50
Solid Books	1.25	@	1.30
Blanks	1.50	@	1.65
Krafts	1.00	@	1.25
New Kraft Cuts	1.80	@	2.00
Manila Env. Cuts	2.20	@	2.35
Ex. No. 1 Manila	2.20	@	2.35
Print Manila	1.70	@	1.80
Overissue News	.80	@	.90
Old Newspapers—			
No. 1 Folded News	.80	@	.90
No. 1 Mixed Paper	.80	@	.90
Roofing Stocks—			
No. 1	2.00	@	2.25
No. 2	1.85	@	2.00

TORONTO

Paper

Bonds and Ledgers

Delivered

No. 1 White	.35½	@	.36½
No. 1 Tints	.36½	@	.37½
No. 2 White	.26½	@	—
No. 2 Tints	.27½	@	—
No. 4 White	—	@	.1550
No. 4 Tints	.16	@	.1650
No. 5 Bond—White	.11.35	@	—
No. 5 Bond—Tints	.12.35	@	—
No. 5 Bond—Golden Rod	.13.35	@	—
No. 5 Ledger—White	.1185	@	—
No. 5 Ledger—Tints	.1285	@	—
No. 6 Bond—White	.10.75	@	—
No. 6 Bond—Tints	.11.25	@	—
No. 6 Bond—Golden Rod	.12.75	@	—
No. 7 Bond—White	9.10	@	—
No. 7 Bond—Tints	9.60	@	—
No. 7 Bond—Golden Rod	.11.10	@	—
Book—			
No. 1 M. F.	7.10	@	7.35
No. 2 M. F.	6.85	@	7.20
No. 3 M. F.	5.60	@	6.20
No. 1 S. C.	7.60	@	7.85
No. 2 S. C.	7.10	@	7.35
No. 3 S. C.	6.10	@	6.35
No. 1 Coated and Litho	.12.50	@	—
No. 2 Coated and Litho	.11.00	@	—
No. 3 Coated and Litho	9.50	@	10.00
Coated tinted	.13.00	@	13.50
Wrapping—delivered—			
Rag Brown	4.85	@	5.55
White Wrap	4.00	@	—
"B" Manila	4.90	@	6.25
No. 1 Manila	5.50	@	7.00
Fiber	5.50	@	—
Kraft, No. 2	5.50	@	—

(F. o. b. Cars, Toronto)

News, per ton—			
Rolls (contract)	38.50	@	—
Sheets	45.50	@	—

Pulp

Ground wood	32.00	@	—
Unbleached Sulphite	59.00	@	—
Book (Class 1)	71.00	@	—
Writing (Class 2)	72.00	@	—
Select (Class 3)	73.00	@	—

Old Waste Paper

(In carload lots, f. o. b. Toronto)

Shavings—			
White Env. Cut	2.50	@	—
Soft White	2.15	@	—
White Blk. News	1.25	@	1.40
Book and Ledger—			
Flat Magazine and Book Stock (old)	1.00	@	—
Light and Crumpled Book Stock	.85	@	—
Ledgers and Writings	1.20	@	—
Manilas—			
New Manila Cut	1.50	@	—
Printed Manilas	.65	@	—
Kraft	1.00	@	1.70
News and Scrap—			
Strictly Overissue	.65	@	—
Strictly Folded	.60	@	—
No. 1 Mixed Paper	.50	@	—

Domestic Rags

(Price to mills, f. o. b. Toronto)

No. 1 White Shirt Cuttings	.09	@	.09¼
Fancy Shirt Cuttings	.03½	@	.03¾